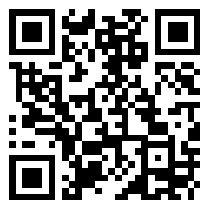


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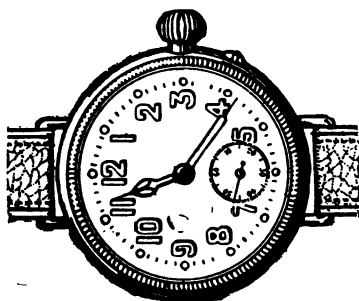
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## Monomial Formulas for Pressure and Velocity for Ordnance and Small Arms Firing Colloid Powders

BY CAPTAIN J. H. HARDCASTLE, *pac.*, R.A.

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*Continued from page 354.*

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### SECTION VII.

The apparent discrepancy between the monomials for ordnance and small arms. Account of experiments.

The most superficial examination of Tables II and IV, reveals a serious difference in the percentage change in pressure or velocity as between rifles and heavy guns, when the weight of the charge alone is altered. For ordnance an increase of charge by 10% increases the maximum pressure by about 15% and the velocity by about 6%, whereas the same increase of charge in a rifle gives 25% greater pressure and 10% greater velocity. The difference is so great as to be arresting, being about the difference between momentum and energy. The velocity percentages are so well known to the two trades of artillery and rifle cartridge makers, each to each, that each may be said to scoff at the idea of using the other's percentage and to ascribe the difference without hesitation to the so-called natures of the weapons. The forcement and the barrel lengths are so different, as also the cooling surface of the bores and the proportion of powder to shot, that further thought seems wasteful, the whole subject being so complex. The ballistics of the new United States Springfield cartridge gave me the first hint of the explanation. With that rifle the normal charge is 43 grains of chopped up tubular and 150 grain bullet, giving a velocity of about 2600 f/s for a pressure of 21 tons. I have particulars of experimental firings with bullets from 150 to 200 grains, altered 10 grains at a time. From these it appears that 10% in the charge gives 15% in the pressure and 8% in the velocity, and the change in the bullet gives only normal changes. It follows then that the rifle percentage can approximate to that of ordnance and it only remains to find the condition by experiment.

The most obvious difference between ordnance and rifles is in the material of the projectile, lead with a cupronickel envelope as against iron with a copper driving band, so a beginning was made by firing from the Lee-Enfield rifle brass bullets of 0.302 diameter with a driving band one sixteenth of an inch width and 0.005 inch

thick. It was found that the velocity varied as usual directly as the charge. The weight of the brass bullet was then reduced to 100 grains,

making  $\frac{W}{d^3}$  as for ordnance and about 0.4. This had no effect. The

length of shot travel for a 0.450 express rifle is little more than 50 calibres and for a 600 bore it is less than 40 calibres. The size of the chamber is not the condition because the 12 inch Mark VIII chamber is proportionately nearly the same size as the 0.303 rifle chamber. This leaves only the size of the explosive and the density to be examined. Ordnance fire at a density of about 0.4 and use cords about one twenty-fifth of a calibre in diameter. Rifles fire at a density of from 0.6 to 0.8 and their cords run about ten to the calibre. I happened to have the use of a 0.280 rifle bored out to 0.340 inch from the muzzle right down to the neck of the cartridge and enlarged for two inches in front of this neck to 0.350 inch. The powder chamber was therefore nearly 0.5 cubic inches, so that I could safely fire 70 or 80 grains of M.D. strip from it. I also took sporting ballistite from 12 bore cartridges and found it to be about 0.004 inch thick and in accurate flakes. Naturally care was necessary not to burst the guns with the latter powder as it is little more than one-hundredth of a calibre thick. Using from 10 to 22 grains of ballistite varying by 2 grains at a time behind a 210 grain bullet in a service rifle the index of the charge for velocity was 0.6 or the same as for ordnance. The densities were from 0.44 to 0.20 and 75 thicknesses made one calibre. The highest pressure was over 20 tons, but pressures were not accurately taken throughout the series. The velocity of the 22 grain charge was 2080 f/s.

With the bored up 0.280 rifle firings were carried out with various charges of axite and weights of bullet. The chamber was altered in size by locating the driving band on the shot so as to fill up with the body of the shot any desired amount of the chamber and make it anything from 0.27 to 0.45 cubic inches. The charges ran from 35 to 70 grains and the shot from 160 to 375 grains. The velocities obtained are represented accurately by the following equation :

$$* \log V = K + 0.7 \log w - 0.3 \log W - 0.25 \log C$$

Where  $w$  and  $W$  are in grains,  $C$  in cubic inches and  $V$  in f/s. The highest velocity was 3220 f/s and the lowest 1600 f/s. No pressure came up to 18 tons. The densities were from 0.36 to 0.63 and 20 thicknesses made one calibre.

The thickness of the explosive is therefore not the disturbing element, as the index of the charge is 0.7.

Five other powders were tried in this experimental gun and the 303 rifle.

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\* The value of  $K$  was sensibly equal to that calculated from the formula for M.D.T. (ordnance) with the ordnance constant. It is therefore omitted as there is no object in publishing it.

M.D.T.	from	Mark VII 303	Cartridges.
M.D. Strip	"	375/303	"
American tubular	"	280 Ross	"
Moddite	"	280 Ross	"
Mark I. Cordite	3¾ "	Mark VI. 303	"

They confirmed the conclusion which I arrived at by the argument in the detailed experiments that the index of the charge in the velocity equation varies distinctly with the density of loading. Perhaps some such index as  $\Delta + 0.2$  might be fitted in, if care was taken to adjust the numerical coefficient  $K$  at each shift of the index in the equation  $V = K w^{\Delta + 0.2}$ , where  $\Delta$  is altered by increments of 0.1 at a time so as to make  $V$  run on a continuous curve after the fashion of  $p = \frac{Cr}{g}$  in the new exterior ballistic tables.

Charbonnier on page 283 of his book arrives at the index  $\frac{2-\Delta}{1-\Delta}$  for  $w$  in his pressure equation already quoted but he does not form a simple monomial as he retains the total air volume as one term instead of distributing it as I am wishing to do between the chamber and the charge, of both of which it is a function.

## SECTION VIII.

### A MONOMIAL FOR THE POINT OF COMPLETE COMBUSTION.

In Section I.  $x$  was given in terms of other quantities so that we can write

$$\bar{u} = \frac{2.94 a^2 w \bar{X}}{d^2}$$

As before stated  $\bar{X}_0$  varies as  $x^{0.38}$

and  $\Sigma$  varies as  $\bar{X}_0^{0.7}$  for cords and as  $\bar{X}_0$  for tubes, so that  $\bar{x}$  varies as  $\Sigma^{3.76}$  for cords and as  $\Sigma^{2.63}$  for tubes, and

$$\Sigma = \frac{W V^2}{P_m} \frac{2.16}{W a^2 X_2}$$

We have then for cords

$$\bar{u} = K \left( \frac{V^2}{P_m} \right)^{3.76} w^{+0.73} W^{+3.76} C^{-2.58} u_0^{-0.90} d^{-3.80}$$

and for tubes

$$\bar{u} = K \left( \frac{V^2}{P_m} \right)^{2.63} w^{+0.89} W^{+2.63} C^{-1.89} u_0^{-0.63} d^{-3.26}$$

By combining Tables II and IV, the value of  $\frac{V^2}{P_m}$  can be obtained and by raising it to the proper power and combining it with the rest of the expressions for  $\bar{u}$  the following table of indices of  $\bar{u}$  results,



showing the travel to the point of complete combustion as monomial, and leaving the constant to be determined by the method of Section I.

TABLE V. INDICES for  $\bar{u}$ .

	$w$	$W$	$C$	$l_0$	$u_0$	$d$
N/c T.	- 0.40	- 0.53	+ 0.19	+ 2.11	0	+ 1.12
M.D.T.	- 0.66	- 0.53	+ 0.08	+ 3.16	0	+ 2.70
M <sup>*</sup> I and M.D. Ordnance	- 0.85	- 0.75	- 0.70 - 0.14 *	+ 2.07	0	+ 5.87 + 4.15 *
M.D.T. (rifles)	- 0.54	- 0.18	- 0.08	+ 1.21	0	+ 2.16
M <sup>*</sup> I. (rifles)	- 1.15	- 1.28	+ 0.65 * M.D.	+ 2.26	0	+ 4.08

This Table is a very delicate test for the accuracy of the Indices in Tables II and IV, because it contains the velocity indices raised to the power of 7.52 or 5.26 and the pressure indices to half those powers. A small error is thereby magnified. Also the equations

for  $\bar{u}$  just given are derived from a theory more convenient than strict and by an approximate method. The index of  $W$  should always be negative and of  $l_0$ , and  $C$  positive.  $u_0$ , the length of the gun itself should vanish leaving the index of  $d$  greater than + 1.00. It is not obvious from first principles whether the index of  $w$  is always positive or negative, although it is clear that it does not necessarily vanish. It is certainly possible with a rifle to diminish the powder weight till unburnt powder is left in the bore and blown out of the muzzle, which necessitates a negative index of  $w$ . There seem to be only four errors in the table. They are the negative values in the  $C$  column and a very little sophistication will adjust them. If,

however, in the definition,  $a^2 = \frac{1}{\Delta} - \frac{1}{\delta}$  the specific gravity  $\delta$  is taken as 1.0 instead of 1.57, the indices of  $w$  and  $C$  become very different so as to seem absurd, yet Charbonnier on page 14 makes the co-volume  $\frac{1}{\delta}$  or  $\eta$  equal to unity as the result of experiment.

He justifies this value by saying that the specific gravity of smokeless powder at 1000° Centigrade may well be unity. I have often used a cigarette paper lightly crumpled as a wad and have always found it a few feet from the muzzle after firing at 20 tons pressure. It is then rather ragged but all of it and the gum can be accounted for and there is no sign of fire.

## SECTION IX.

Application of the Formulas to the Penetration of Armour.

The largest guns are made for the express purpose of piercing the enemy's armour. There are many formulas published for ascer-

taining the approximate thickness of armour which can be penetrated by a given shot and they are mostly arranged in terms of the striking velocity  $v$  f/s the thickness of armour  $t$  inches, the calibre of the gun  $d$  inches and the weight of the shot  $W$  lbs.

I am not aware that the penetration has yet been published in terms of the symbols of interior ballistics or in other words that a formula has yet been devised to show explicitly the conditions for maximum penetration or efficiency of gun. It comes out of the monomial formulas very simply.

Krupp's formula for K.C. armour is

$$v^2 = \frac{t^2 d}{W} \log^{-1} 6.3532$$

which is practically equivalent to

$$t = \frac{1}{4} \sqrt{\frac{\text{S. E.}}{d}} \text{ where S.E. is the striking energy in foot-tons.}$$

The first step is to obtain a simple expression for the striking velocity in terms of the muzzle velocity  $V$  f/s, the weight and the calibre of the shot and the range  $R$ . yds. No exact expression can be found of course, but when

$V$  is between 2500 and 3000

and  $R$  is between 5000 and 10,000

and  $\frac{W}{d^2}$  is between 6.0 and 12.0 (with  $n = 1.00$ )

$$v = \left[ 0.741 \right] \left( \frac{W}{d^2} \right)^{0.3} V^{1.0} R^{-0.3}$$

is a formula which is never very far out for practical armour piercing guns. To eliminate the range  $R$  from the expression for  $v$ , it is best to name it as  $O$ , 5000 or 10000 and to give to  $\frac{W}{d^2}$  separate

indices,  $O$ , 0.22 and 0.4 to correspond with the named range. The index 0.3 is then suitable for a fighting range of about 7000 yards

and  $v$  at 7000 yards varies as  $\frac{W}{d^2}^{0.3} V^{1.0}$  Putting this value into the penetration formula

$$t = K W^{0.5} v^{1.0} d^{-0.5}$$

we have

$$t = K W^{0.8} v^{1.0} d^{-1.1}$$

which is a monomial of interior ballistics

$$\text{At 10000 yards } t = K W^{0.9} V^{1.0} d^{-1.3}$$

$$\text{and at 5000 yards } t = K W^{0.7} V^{1.0} d^{-0.9}$$

$$\text{and at the muzzle } t = K W^{0.5} V^{1.0} d^{-0.5}$$

With the 7000 yard formula and the monomials for M.D. cords where

$$V = K W^{-0.3} d^{-0.12} \text{ from Table IV.}$$

and

$$P_m = K W^{+0.6} d^{-2.81} \text{ from Table II.}$$

$$t = K W^{0.5} d^{-1.22}$$

If  $\frac{W}{d^3}$  is a constant,  $t = K d^{+0.28}$  and  $P_m = K d^{-1.01}$

or if  $\frac{W}{d^2}$  is a constant,  $t = K d^{-0.22}$  and  $P_m = K d^{-1.61}$

where the maximum pressure falls in both cases as the calibre increases, but the penetration increases when  $\frac{W}{d^3}$  is a constant and diminishes when  $\frac{W}{d^2}$  is a constant.

The next step is to trace the change in penetration for a constant maximum pressure.

From Table II it is easy to construct another table showing by how much per cent. each item of the loading must be changed to produce + 10% in maximum pressure. The rifle powders are inserted for convenience and also because they apply to ordnance at certain densities of loading.

TABLE VI. Percentage to alter  $P_m$  by + 10%

	N/c T.	M.D.T.	M <sup>k</sup> I. & M.D.	M.D.T. rifle	M <sup>k</sup> I rifle
$w$	+ 6.25	+ 5.56	+ 6.18	+ 4.25	+ 4.0
$W$	+ 16.7	+ 16.7	+ 16.7	+ 14.9	+ 14.3
$C$	- 9.09	- 10.0	{ - 10.0 - 8.7 *	- 6.67	- 6.25
$l_o$	- 7.14	- 7.14	- 11.8	- 5.56	- 6.25
$d$	- 5.26	- 3.57	{ - 3.56 - 4.24 *	- 3.63	- 3.13

EXAMPLE: + 6.25% in charge of N/c T. alters maximum pressure by + 10%.

\* M.D.

Every alteration shown in the table above causes also an alteration in velocity. By means of Table III the equivalent percentage change in velocity can be worked out and is shown in the next table.

TABLE VII. Percentage change in velocity due to + 10% P

	N/c T.	M.D.T.	M <sup>k</sup> I. & M.D.	M.D.T. rifle	M <sup>k</sup> I. rifle.
+ $w$	+ 4.07	+ 3.89	+ 3.70	+ 4.25	+ 4.00
+ $W$	- 5.00	- 5.00	- 5.00	- 2.99	- 4.57
- $C$	+ 2.27	+ 2.50	{ + 2.50 + 2.17 *	+ 3.33	+ 2.31
- $l_o$	+ 2.14	+ 2.14	+ 1.77	+ 3.72	+ 3.13
- $d$	+ 0.63	+ 0.97	{ + 0.43 + 0.51 *	+ 1.27	+ 1.72

EXAMPLE: Increasing the pressure + 10% by increasing the N/c T. charges + 6.25% also increases the muzzle velocity by + 4.07%.

\* M.D.

Every alteration in the velocity causes also an equal alteration in the penetration by means of the index 1.0 of  $V$  in the formula for 7,000 yards penetration

$$t = K W^{0.8} V^{1.0} d^{-1.1}$$

In addition the indices of  $W$  and of  $d$  cause separate and additional alterations in the penetration thus, taking cordite M.D. as an example :

+ 10% in  $W$  gives + 8% in  $t$  and from Table VI. + 16.7% in  $W$  gives + 10% in  $P_m$  or + 13.36% in  $t$ .

But by Table VII. + 16.7% in  $W$ . changes  $V$  by - 5.0%, so that the total change in  $t$  due to a change of + 16.7% in  $W$  is + 13.36% - 5.0% or + 8.4%. In this way Table VIII. has been constructed.

TABLE VIII.

Percentage change in penetration at about 7000 yards due to + 10% change in  $P_m$

	N/c T.	M.D.T.	M <sup>k</sup> I. & M.D.	M.D.T. rifle.	M <sup>k</sup> I. rifle.
+ $w$	+ 4.07	+ 3.89	+ 3.70	+ 4.25	+ 4.00
+ $W$	+ 8.4	+ 8.4	+ 8.4	+ 8.9	+ 6.8
- $C$	+ 2.27	+ 2.50	{ + 2.50 + 2.17*	+ 3.34	+ 2.32
- $l$	+ 2.14	+ 2.14	+ 1.77	+ 3.72	+ 3.13
- $d$	+ 6.42	+ 4.90	{ + 4.35 + 5.17*	+ 5.27	+ 5.16

EXAMPLE: Increasing  $P_m$  by + 10% by increasing the N/c T. charge by + 6.25%, increases the penetration by + 4.07%.

The meaning of this table is on the surface even though the figures may contain numerous approximations. It accords with Greenhill's and Whitworth's prediction that we shall have projectiles

with  $\frac{W}{d^8} = 0.7$  instead of 0.45 fired from the heaviest guns.

Tables VI. and VII. also indicate that the present size of the chambers of guns can be largely reduced if the thickness of the powder is increased. This would give an advantage in penetration at the cost of a slight increase in the forward pressures but of none in the maximum pressures.

When the chamber has been so much reduced that the charge fills it, the pressure can be kept constant by reducing charge, size and chamber together without materially affecting the penetration.

It seems that penetration depends more upon maximum pressure than anything else and that there are many ways more economical than increasing the calibre to increase penetration.



## SECTION X.

## Application of the Formulas to Small Arm Design.

A change of notation. Two examples.

Problems connected with small arms can be attacked by this monomial method and solved on the same lines as the problem of armour. The principal results of exterior ballistic calculations for modern military rifles can be expressed as a first approximation as monomials and then combined with the formulas of interior ballistics. A slight change in notation will be convenient both to avoid confusion and to facilitate logarithmic work. The weight of the bullet and charge will be  $W_1$  and  $w_1$  when expressed in grains,  $U$  will be the shot travel in inches and  $L$  will be  $2 l_p$ . Also  $R$  is the range in yards,  $H$  the greatest height of the trajectory in feet,  $n$  the coefficient of reduction,  $T$  the time of flight in seconds,  $v$  the remaining velocity in f/s,  $\phi$  the angle of projection in minutes,  $\theta$  the deflection in minutes due to a cross wind,  $M$  the speed of a cross-wind in miles per hour and the other symbols as usual.

The monomials of exterior ballistics are then

$$\begin{aligned} R &= [1.853] V^{0.83} \left(\frac{W}{n d^2}\right)^{0.25} H^{0.36} \\ v &= [1.360] V^{1.0} \left(\frac{W}{n d^2}\right)^{0.6} \left(\frac{1}{R}\right)^{0.5} \\ \phi &= [4.280] \left(\frac{1}{V}\right)^{2.0} \left(\frac{n d^2}{W}\right)^{0.7} R^{1.33} \\ \theta &= [0.133] \left(\frac{1}{V}\right)^{1.2} \left(\frac{n d^2}{W}\right)^{1.2} R^{1.2} M^{1.0} \end{aligned}$$

The limit of substantial accuracy of these formulas is about the range at which accurate target practice can be expected. The formula for the remaining velocity is most limited as it is only constructed for  $V$  between 2500 and 3100

$C$  „ 0.4 and 0.8

$R$  „ 700 and 1300

It will also be noticed that  $H$  varies as  $n^{0.695}$  or say  $n^{0.7}$ .

As an example of the method a rifle firing M.D.T. or M.D. Strip, called axite by Ingalls, will be taken and the constants will be obtained from the Mark VII. cartridge for the Lee Enfield.

$W_1 = 175$ ,  $w_1 = 38$ ,  $C = 0.210$ ,  $L = 0.015$ ,  $U = 23.3$   
 $d = 0.303$ ,  $V = 2450$ ,  $P = 18.0$ . Then

$$V = [0.351] w_1^{+1.0} W_1^{-0.2} \left(\frac{1}{C}\right)^{+0.5} \left(\frac{1}{L}\right)^{+0.6} U^{+0.12} \left(\frac{1}{d}\right)^{+0.35}$$

$$P = [10.307] w_1^{+2.35} W_1^{+0.67} \left(\frac{1}{C}\right)^{+1.5} \left(\frac{1}{L}\right)^{+1.8} \left(\frac{1}{d}\right)^{+2.76}$$

From Tables VI. and VII. + 10%  $P_m$  is given by the following changes

+ 4.25%  $w_1$ , + 14.9%  $W_1$ , - 6.67%  $C$ , - 5.56%  $L$ , - 3.63%  $d$ .  
and these changes produce changes in  $V$  as under each one

+ 4.25%      - 2.98%      + 3.34%      + 3.72%      + 1.27%

In combination with the monomial involving  $H$  of exterior ballistics, the range of a fixed sight trajectory  $R$  is altered

+ 3.53%      + 1.25%      + 2.77%      + 3.09%      + 1.20%

It appears then that if the powder charge is altered by + 4.25% and the bullet weight by - 14.9% the pressure remains unchanged and the fixed sight range is increased by + 3.53% - 1.25% or by + 2.28%, say 16 yards in 700.

Another and more extensive application of the method is now given as a practical example viz:—to design a new rifle. In the formula connecting  $H$  and  $R$  substitute for  $V^{0.83}$  the value from the interior ballistic monomial

$$V^{0.83} = \left[ 0.291 \right] w_1^{+0.83}, \text{ etc.}$$

make  $H = 5.25$  or  $0.36 \log H = 0.259$ . Then

$$R = \left( \frac{1}{n} \right)^{0.25} \left[ 1.442 \right] w_1^{+0.83} W_1^{+0.084} \left( \frac{1}{C} \right)^{+0.415} \left( \frac{1}{L} \right)^{+0.556} \\ U^{+0.10} \left( \frac{1}{d} \right)^{+0.79}$$

Then if  $\frac{w}{d^2} = 0.26$  (as a reasonable condition)

$$R = \left( \frac{1}{n} \right)^{0.25} \left[ 1.716 \right] w_1^{+0.83} \left( \frac{1}{C} \right)^{+0.415} \left( \frac{1}{L} \right)^{+0.556} \\ U^{+0.10} \left( \frac{1}{d} \right)^{0.622}$$

This shows that when the sectional density is fixed, the fixed sight range increases as the calibre diminishes, if no notice is taken of the maximum pressure.

If  $W_1 = 150$  (as the smallest permissible weight of a bullet)

$$R = \left( \frac{1}{n} \right)^{0.25} \left[ 1.625 \right] w_1^{+0.83} \left( \frac{1}{C} \right)^{+0.415} \left( \frac{1}{L} \right)^{+0.556} \\ U^{+0.10} \left( \frac{1}{d} \right)^{+0.79}$$

The range again increases, and faster too, as the calibre diminishes. To examine the effect of the pressure more closely, we will go to the limit and suppose that the largest chamber permissible is 0.30 cubic inches. This will hold (say) 65 grains of M.D.T. The lightest bullet is 150 grains and the greatest pressure 20 tons/inch<sup>2</sup>.

From the pressure formula the annulus to give 20 tons pressure is worked out for calibres of 6, 7 and 8 m/m or 0.236, 0.276 and

0.315 inches and thence the other particulars follow and are

$d$	0.236	0.276	0.315	0.303 Mark VII
$L$	0.0292	0.0230	0.0188	0.015
$\frac{W}{0.65, d^2}$	0.592	0.433	0.333	0.42
$\frac{W}{0.55, d^2}$	0.700	0.512	0.394	—
$R$ (for $n = 0.65$ )	752	760	766	678
$R$ (for $n = 0.55$ )	783	793	800	—
$V$	2518	2805	3055	2450
$\theta$ for $\begin{matrix} n = 0.65 \\ M = 10 \\ R = 10000 \end{matrix}$	8.4	10.6	13.1	13.1

All these charges are burnt inside the gun and the pressure is naturally well sustained to the muzzle producing a rather heavy muzzle blast. Two values of  $n$  are shown as a reminder that the shape of the bullet is very important.

These particulars enable a choice of calibre to be made to suit special requirements and it will be observed that the calibre hardly affects the fixed sight ranges when the maximum pressure is fixed. Its reduction reduces the wind allowance enormously at the cost of striking energy at short range. At ranges for which the striking velocity monomial is applicable say 700 to 1300 yards the advantage of a small calibre begins to assert itself. The remarks at the end of Section IX. about the size of the chamber are equally applicable to rifles. The advantage of a large cartridge case and a heavy charge is greatly overestimated and the latter in especial greatly accelerates wear and erosion as the large volume of incandescent gas is very hard on the barrel. Diminution in the size of cordite can compensate to a large extent for reduction of charge and the use of strip instead of tubular economises space where it is valuable.

Table IX. shows how ballistics can be adjusted to suit any requirements and a study of it would seem likely to repay the student, and to upset many preconceived ideas.

TABLE IX. for M.D.T. rifle alone.

	$w$	W	C	L	$d$	
%	+ 4.25	+ 14.9	- 6.67	- 5.56	- 3.63	% changes to alter $P_M$ by +10%
%	+ 4.25	- 2.99	+ 3.33	+ 3.72	+ 1.27	% changes in V due to +10% in $P_M$ twice this gives % of muzzle energy.
%	+ 3.52	+ 1.25	+ 2.77	+ 3.08	+ 2.86	% changes in range of trajectory H feet high, due to +10% change in $P_M$
%	- 9.80	- 3.53	- 7.68	- 8.57	- 8.01	% changes in height of trajectory of R yards due to +10% change in $P_M$
%	+ 4.25	+ 5.96	+ 3.33	+ 3.72	+ 5.63	% change of remaining velocity at about 1000 yards due to +10% change in $P_M$
%	+ 8.5	+ 26.8	+ 6.66	+ 7.44	+ 11.26	% change in striking energy at about 1000 yards due to +10% change in $P_M$
%	- 8.5	- 4.43	- 6.66	- 7.44	- 7.62	% change in angle of elevation at R yards due to +10% change in $P_M$
%	- 5.10	- 14.30	- 4.00	- 4.46	- 10.29	% changes in wind allowance, R and M constant due to +10% change in $P_M$

*Example.* Reducing the calibre by 3.63% increases the pressure by 10% and the velocity by 1.27%. It also reduces H by 8.01%,  $\phi$  by 7.62% and  $\theta$  by 10.29% and increases R by 2.86%,  $v$  at medium ranges by 5.63% and striking energy at medium ranges by 11.26%, but muzzle energy by only 2.54%.



## SECTION XI.

The Index of  $u$  in the Velocity Monomial. The Waves of Hugoniot.

In selecting the value of 0.12 for the index of the shot travel  $u$  many old reports of experiments were consulted before it was decided to adopt a simple numerical index instead of one involving some function of the density or of the equivalent length of chamber. The only known rule for modern rifles was that promulgated by "The Field" that two inches of barrel gave 50 f/s of velocity as an average. The first simple experiment showed this to be untrustworthy. The published experiments were only two in number. Sir Andrew Noble's results with his 100 calibre 6 inch gun, and Ingalls' example of Springfield rifle shortened inch by inch given on page 130 of his third edition. For both these a mean result is that 8% in travel gives 1% in velocity. On the 17th Aug., 1912, "The Field" published results of shortening a service rifle barrel by 5 inches at a time, for which the same percentage rule applies nearly. The experiments in my possession were performed by the late Mr. Housman with the service rifle in September, 1902. The barrel was cut down successively to 30, 24, 18, 14 and 11 inches, and three series fired with each length with Mark II. bullet for both pressure and velocity. One series was with the service load and conditions, the second with the bullets oiled and barrel wiped out with oil between shots, and the third with a two thirds charge of the same cordite. The percentage already quoted was found to be suitable for all the results. I have done other experiments myself, cutting the barrel down inch by inch till the brass cartridge case was flush with the muzzle, and there was no lead or barrel at all.

These latter experiments confirmed the former, and also have led me to believe that Hugoniot's waves manifest themselves in rifles. These waves are discussed by Charbonnier, beginning on page 86, and are of the same nature as the waves of pressure occasionally observed in closed vessel experiments when the vessel is rather long for its diameter. The tornado of gas behind the shot is subject to the ordinary laws of vibration, and is swept by periodic longitudinal waves of such close frequency that as a rule the resulting fluctuations of acceleration are merged into a mean acceleration. But Ingalls' figures already mentioned show irregularities such as would result from Hugoniot's waves. The two third charge of the Housman experiments give results which seem only accountable for on some such supposition. No experimental error could account for them. The observed velocities were as follows:

30 inch barrel velocity was	1110 f/s
24 " " " "	1188 "
18 " " " "	1050 "
14 " " " "	1008 "
11 " " " "	987 "

where the 1110 f/s is not due to barrel friction alone, but the 1188 f/s is due to surge of pressure.

## SECTION XII.

## OBITER DICTA.

There are a few points arising from the previous sections which are unclassified but which should be mentioned to save confusion of thought. Notable amongst these are the effects of the cartridge case and cap and cone or lead with fixed ammunition whether for rifles or ordnance. The chamber capacity is undoubtedly properly defined as all the air space behind the shot when it is just sealing the bore together with the volume of the combustible material in the case. I prefer however to distinguish and keep that as the true capacity, to call the proportion of it behind the shot before the charge is fired by the name cap-chamber and in all questions of design to have both of them specified. They are not interchangeable nor is one a simple multiple of the other. The size of the cap chamber determines the strength of the cap quite as noticeably as the size of the fire holes. The strength of the cap determines the ignition of the charge proper as much by the size of the cap chamber as by the strength of the striker blow or the quantity and quality of the cap composition together with the igniter when used. The ignition has a real effect upon the maximum pressure and thence on the muzzle velocity and in prophesying the maximum pressure the ignition must be taken into account quite as much as the temperature of the charge. The forcement also or the pressure necessary for engraving the bullet or driving band with the rifling marks has its own effect on maximum pressure and so on velocity.

After much thought and comparison I am inclined to think that all of these factors disturbing the maximum pressure should be adjusted by sophisticating the thickness of the cord or annulus and not by varying the constant in the pressure and velocity monomials. One variation then acts on both the pressure and velocity equations and serves as a check on the assumption of an increased or diminished thickness, as a convenient fictitious size differing by perhaps 5 or even 10 per cent from the real measured thickness. Differences between one maker's cordite and another's are so arranged in fact to give identical ballistics and there seem other logical reasons for adopting this method of correcting.

A caution is necessary in dealing with the reconciliation attempted in Section VII. The cooling surface of the bore per lb of powder is sensibly greater in small arms than in ordnance so that a difference might well be expected. In reconciling the velocity equation I must not be supposed to have also said that I expected some day to be able to reconcile the pressure formulas. I have most certainly not done so yet and I am inclined to think that though the effective area under the pressure space curves may be the same, the maximum pressures are really different. In the same way when dealing with howitzer charges and charges for low power ordnance such as field guns there may be found a real difference between their equations

and high power guns or rifles. The time of cooling possibilities is almost of a different order of time.

One more point requires a word. Attention is naturally drawn to the similarity between tubular and strip by the similarity of their pressure and velocity formulas. No examples have been given, but common sense says that a strip is only tubular split down one side and opened out flat and that the initial burning surfaces are nearly the same. The neglect of the strip shape is perplexing as it is easier to make and should be no less regular in burning than well made tubes, which are not found to burst open,\* and in addition it packs better and more closely. This packing power is very noticeable in the case of rifle cartridges. 60 grains of M.D.T. fill a case which holds 65 grains of strip or axite, a most important thing when space is strictly limited.

### SECTION XIII.

#### Recapitulation and Conclusion.

This section may well take the form of a series of statements for brevity's sake.

I. Ingalls' method based upon two definite assumptions is near enough to the truth to give good results in practice.

II. It leads to a particularly quick way of drawing continuous velocity and pressure curves when the whole of the ballistic data are to hand.

III. It affords the only reliable way of arriving at the point of complete combustion in a reasonable number of minutes work.

IV. Charbonnier's expression for the first term of the formula for maximum pressure affords some useful assistance in elaborating a monomial.

V. The best theories are so indefinite in their numerical results that they are of little use.

VI. The monomial method associated with the name of Sarrau and checked continually by actual practice is the best for everyday use and seems to be the only proper method in our present state of knowledge.

VII. The method shown at full length in Appendix III is a most useful tool.

VIII. Results within 5% for velocity and pressure are the limits of accuracy with the usual insufficient data supplied.

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\* Captain T. G. Tulloch, late R.A., informs me that experiments have been made with tubular made purposely much too thick. All that was picked up of that blown out of the muzzle unburnt was perfect and quite even. It was made up into another charge and was picked up again without any being burst open.—J.H.H. 4/4/14.

IX. There is a large field for research using two guns of 0.5 and 1.0 inch calibre, of variable length and with variable chambers, as one batch of cordite can be used giving two precise values of thickness when measured in calibres. A few rounds fired for pressure and velocity will give all information about a new powder at a nominal expense, as the principle of mechanical similitude can safely be assumed.

X. The monomial method of combining problems of interior and exterior ballistics allows of a very close first approximation to the answers to all questions of design of guns and rifles. In particular it brings into view the real effect of arbitrary manufacturing limits and points out clearly and with little labour the lines for future advance in design.

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*End of Article.*





## SOME POINTS CONNECTED WITH DISCIPLINE.

A LECTURE

BY THE LATE HEADMASTER OF MALVERN COLLEGE.

COMMUNICATED BY MAJOR H. B. HILL, R.A.

I make no apology for addressing you. Long before I have finished you will realise that no apology could possibly be adequate. *I hope at any rate to provoke discussion.*

I will begin by quoting in substance the closing sentences of a lecture which Mr. Spenser Wilkinson, Professor of Military History in Oxford University gave to Officers and N.C.O's at Epping some weeks ago on training—they will serve as an introduction, and will do away with the necessity of definitions, which in such matters as this are a delusion and a snare, for discipline has various meanings.

“You may have the best weapons, the latest scientific appliances, the most highly trained Officers, but unless all ranks from the highest to the lowest are pervaded with the spirit of discipline no army can count on being successful.

Discipline means much more than mere obedience. *The common life of soldiering educates us all. We must live that life while we are at it and no other.* Every Army, every unit of that Army, is not a machine but a living organism, and if that organism is to carry out its function properly there must be no weak spots.”

The secret of all true discipline lies in mutual confidence and trust. To be trusted we must be worthy of trust. To be worthy of trust we must each of us, from the highest to the lowest, train ourselves and be trained as thoroughly and as conscientiously as possible, physically, mentally and morally.

Discipline in its fullest and highest sense means the training of character, and the problem is to secure exact obedience without interfering unduly with the enjoyment of legitimate freedom. No one has less independence than he who has never learnt obedience.

I approach the subject mainly from the Schoolmaster's point of view, though, when I was an assistant master at Eton, I served 18 years in the School Corps and passed through all the grades from private to Commanding Officer of the battalion, and so gained a certain amount of experience. I then went to Malvern College in 1897 as Headmaster, and was in a general way responsible for the discipline of the whole School. The maintenance of discipline therefore in different conditions and in various positions formed a considerable element in my life, for 35 years.

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Now we have all been school boys, some of us alas! a long time ago, but memories of school life remain fresh in the mind, and probably in our school life we all came across some masters who were good disciplinarians and some who were apparently helpless in that respect. (Incidentally let me recommend a most entertaining book called "The lighter side of a Schoolmasters life" by Ian Hay. It is not only very amusing, and by no means technical, but contains a good deal of valuable latent teaching).

In my career as a Schoolmaster, I have found in regard to discipline, 3 classes of men (1) Those to whom the power of maintaining discipline comes naturally : these men have no trouble from the very start, and they are perhaps inclined (some of them) to look with a contemptuous eye upon their less fortunate colleagues. (2) Those who have no idea of discipline; boys have an almost unerring instinct for detecting such incapacity and when they have made sure of their victim they show him no mercy and his life, if, as often happens, he is a sensitive person, becomes a burden. (3) A comparatively small class, men who begin by not knowing how to keep order, but by sheer force of character and perseverance, manage in time to surmount their difficulties and become quite efficient. I have known several of these, and probably they are, in the long run, more valuable than the first class, because they have gone through the mill and can understand and sympathise with the difficulties of others.

I have observed much the same kind of classification among Officers. Of course the officer is to some extent more favourably placed than the Schoolmaster, because the men have not the same chance of making themselves obnoxious as schoolboys have—at any rate the consequences to them of anything like insubordination are far more serious than any which the schoolboy has to expect. But one does see here too some men who are masters of the situation from the first without an effort, others who are never really at ease, others who make themselves efficient by taking pains and this last class I think is more numerous among Officers than it is among Schoolmasters.

N.C.O's perhaps have more difficulties than Officers for N.C.O's are promoted from among the rank and file and have at one time been on a level with the men whom they have to command. On the other hand they know the men better and live more closely with them—just as prefects or monitors at a school do with the other boys. But the principles on which they have to act are the same for all, Officers and N.C.O's alike.

Well, think of a young Schoolmaster, perhaps 23 or so, fresh from Oxford or Cambridge, who has had no experience of teaching, or in the ruling of boys in school hours. He comes to a public school, where there are 400 or 500 boys of all ages from 14 to 19—he is told to take charge of a class of say 30 young and probably skittish boys—he goes into his schoolroom and is confronted with several rows of these cheery youths—he is full of keenness and wants to teach them let us say some Latin. They have—take them all round—no desire

whatever to learn any more Latin than they are compelled to learn. Their first object is to size up the new Master, and a good deal of his future success depends upon what happens in the first few minutes—his voice, his tone, the way in which he speaks to them, whether he gives his orders as though he meant to have them carried out promptly or not, whether there is any trace of nervousness about him, whether he looks as if he were sure of himself, whether he is too polite, too familiar, too pompous, too brutal, too sarcastic, whether his manner is natural or strained. All this and more besides the boys at once note and half unconsciously they decide whether it is good enough to “try it on” or no. The man may be master of the situation in a moment, or he may give himself away and have infinite trouble in regaining lost ground.

One of the least successful disciplinarians I ever knew once read a paper on discipline to a Society of Schoolmasters, coming from various Schools, in which he said “I always establish a reign of terror in my class in the first week of the term.” A fairly sound plan in theory, but I happened to know, though the strangers didn’t, that in practice it was not the boys who were terrified in that particular class. Still the general idea was alright.

I take it that soldier men are in many ways very like schoolboys—they are most of them quite ready to take advantage of any weakness that they may detect in their officers and N.C.O’s and they are pretty sharp in finding out how far they can go with impunity. It is certain that we are not all born disciplinarians nor do I say that everyone can make himself a good disciplinarian—certainly not all at once—but everyone can take steps in that direction, and if there is real strength of character and purpose to back him he will not wholly fail. The first thing is to be sure of yourself; speak as though you mean to be obeyed and in such a way that there is a sort of “snap” in your word of command. A good word of command is an invaluable asset, and moreover it can be acquired by practice. It not only makes the men move smartly, but encourages your inner self. And here I may interpolate a word or two about delivery. You all have not only to give words of command, but to instruct and sometimes to give lectures. It is all important both in instruction and in lecturing to be clearly audible; to pitch your voice at the tone required to reach the most distant part of your squad or audience—to articulate quite distinctly (here my “tip” is to pronounce long words and technical terms slowly, even pedantically and not to be afraid of repeating them, as regards pace to go neither too fast, for then you are not followed, nor too slow, for then you bore your hearers, and above all to speak or read, not as if you were saying a partially learnt repetition lesson like a superior parrot, but as if you understood what you were saying and wanted other people to understand it too.) Of course a good deal of instruction has to be given in the words of the drill book, but I have often noticed Officers and N.C.O’s repeating the words of the book sometimes as though they were a funeral dirge—sometimes—as if they didn’t mean anything at all.

Let us hark back to our young Schoolmaster for a moment—everyone of you have been in a position similar to his. You have taken

a drill or given instruction to a squad or delivered a lecture for the first time and in all probability you felt a certain amount of shyness, even if you didn't show it—you wondered if you were going to make a fool of yourself, and when you came and faced your squad or audience and spoke your first word of command or the first sentence of your lecture, you either knew it was all right from the very start, or the feeling of uneasiness grew upon you and made you uncomfortable, or else it gradually wore off. Anyhow the start was made, and when you finished, and thought it over, suppose that you felt you had not obtained a grip over the men or had failed to keep your audience attentive, to what did you attribute the failure? If you said to yourself it was *their* fault you made a bad blunder—It was *your* fault. And the reason was that you were not sure of yourself. Either you didn't thoroughly know the subject which you were attempting to conduct or else you had not got yourself in hand. Self mastery and self discipline—the power of controlling one's self, keeping one's temper and head—that is the necessary preliminary to the maintenance of discipline over others without friction and without strain. Train yourself if you mean to train other people. Keep your temper—it never pays to get really angry, though it very often pays to pretend to be angry. Don't scold, don't fuss, don't fret, don't snarl, don't nag, and be very careful how you use the weapon of sarcasm if you have a tendency that way: it is dangerous, especially when employed upon people who must not answer back.

Again you must get to know your men off parade as well as on parade or there cannot be the mutual trust which is at the root of all true discipline. You can get to know them quite well without becoming too familiar or allowing the difference between ranks to be ignored. I have heard it said that the familiarity which exists between officers and men in the Colonial forces off parade, has been a source of difficulty as regards their discipline in the field. Join in the men's games and sports when you can—within limits there is no better way of getting to understand the workings of their minds, and the spirit in which they play is often an indication of the spirit in which they work. The sporting spirit is one of the great assets of the British Army.

But with regard to all these points that I have mentioned, I have no doubt whatever that one of the most important factors which go to form the character of the good disciplinarian is the power of judging character, of understanding men (or boys), the possession of that tact which tells you how to treat different types of character rightly, and I believe that, what I must call for the want of a better word, sympathy, is the main element in the acquisition of such powers. There may be two officers equally efficient in every way, but men will work themselves out for one, and for the other they will only do just as much as they are compelled to do and no more. One of these Officers understands men, the other doesn't. We know which of them the men will follow most eagerly at a crisis. In confirmation of this (if confirmation is needed) let me quote what I heard the other day from a young officer just back from the front. Speaking of his relations with his men he said that nothing had helped him so much



in leading the men in what he called unhealthy places as the fact that he had got to know them thoroughly during their training together before they went abroad. He knew them, and they knew him, and they trusted each other. By way of contrast, I met another officer a week or two ago who complained bitterly that drafts were being sent every week to the front from the battalion which he and others had been training for ten months, and that these men were sent off under officers of different units who had never seen the men before—surely a disastrous policy.

I have not hitherto mentioned the subject of punishment and I only mention it now because it is closely connected with the maintenance of discipline, and could not well be omitted, but it is far too large and difficult a subject to enter upon further. Nor will I say much about justice, though justice is the very foundation of discipline. I presume that we all agree that nothing is so likely to upset discipline as any belief on the men's part, well founded or not, that they are not being fairly treated. So avoid anything that could be called favouritism and do your very best to hold the scales of justice even. In regard both to punishment and the keen resentment which they feel against unfairness, imaginary or not, soldiers are very like public school boys. Perhaps it would be too much to say that the officer who punishes least is the best officer, because circumstances vary so much, but I think it *would* be fair to say that, every allowance being made for differing material and differing circumstances, the unit which has the fewest names on its crime sheets is not unlikely to be the most efficient generally, and that the unit in which the officers know the men best and the men know the officers best is the unit which has fewest names on its crime sheets.

As an admirable illustration of much that I have been trying to say let me refer you to Rudyard Kipling's story "His Private Honour." I only wish I had time to quote.

For obvious, not to say disciplinary, reasons I must not say much about senior officers, but as a Headmaster I found that both my colleagues and my officers, (officers and N.C.O's) worked best when they were allowed within clearly defined limits to "run their own show", as the saying is. The Headmaster has to keep a watchful eye upon his subordinates, but, roughly speaking, when once the general aim and scope of their duties is defined the more liberty of action they have in carrying them out, and the more confidence is reposed in them, the better the result will be. No school can be run by the Headmaster alone. No Military unit can be run by the C.O. alone. *But both must keep their eyes open*, however fully they may trust their subordinates.

Perhaps I should be wise to refrain from touching on purely military matters, but I may be allowed to add that in these, as in school management, no detail is unimportant. Discipline is built up on drill and drill on details. The untidy soldier is the man who has no respect for himself has no manners for other people. Smartness of appearance counts for much more than is sometimes thought. I am told that the Guards, who are notoriously particular about smartness in every detail at home, try to maintain their smartness.

as far as may be at the front, and we all know what they have done and are doing there. You of the Artillery, the scientific arm, have more to think of than the Infantry—with your horses and guns to look after and harness and equipment to keep clean, besides your technical work in gunnery and so on, but I should never be surprised to hear that the batteries which look smartest on parade are the batteries which do the best work on active service.

Of course the idea of discipline may be misinterpreted in such a way as to turn an Army into a machine, and when the force that drives the machine breaks down, there comes a smash. But there is a happy medium, when officers and men are component parts of a great living organism, not merely cogs and cranks in a lifeless machine, when they are trained not only to obey the given order but to think for themselves, so that in any emergency, (such, for instance, as the loss of senior officers) the junior officers, the N.C.O's and in the last resort the rank and file, trusting themselves and trusting each other, may be capable of deciding and acting on their own responsibility. Then it will not be said of them as the prophet of old said of the Army of Ahab "I saw all Israel scattered upon the hills as sheep that have not a shepherd, and the Lord said 'These have no master, let them return every man to his house in peace'." And what kind of peace would that be.?



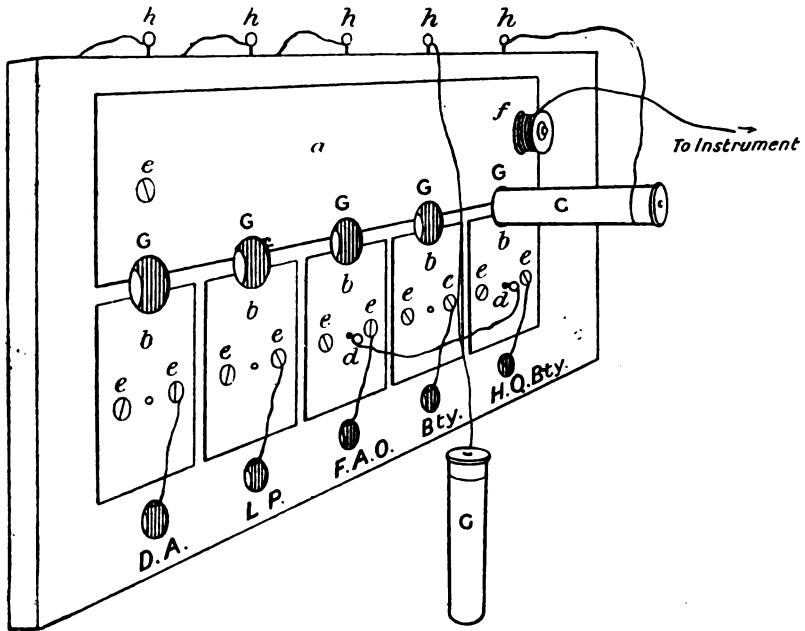
## AN IMPROVISED TELEPHONE SWITCH-BOARD.

BY MAJOR G. K. GREGSON, R.F.A.

WE are continually having to cudgel our brains here to produce the necessary "straw" for our "bricks" and a short description of a telephone Switch Board made from such "straw" may be of interest.

The number of lines to the principal Observing Station of the Battery grew fairly quickly to more than we could manage with our available instruments.

A Switch Board and Exchange became therefore the only possible solution. It was made as follows, vide sketch :—



*a.* Is a strip of metal cut from an 18-pr. cartridge case.

*b.* Are 5 small metal plates from the same case. The long strip and the small plates are secured to a board by means of screws (*e*) from an 18-pr. cartridge box, and by the terminal *f*.

(Holes *G*) for Plugs *C*—the latter being empty '303 Cartridge cases—are drilled through metal and board. To prevent these plugs from being lost they are attached by pieces of string to the loops (*h*) of 5 No. 82 Fuze Pins fixed into the top of the board.

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The lines from the 5 Stations are each brought through a hole (i) in the bottom of the board, and attached to one of the screws (e).

The actual Stations connected to the Board are:—

- I. Divisional Artillery Head-quarters (D.A.).
- II. F.O.O. No. I. (L.P.).
- III. F.O.O. No. II. (F.A.O.).
- IV. The Battery.
- V. Brigade Head-quarters.

It is obvious that anyone of the stations can be spoken to, the remainder being cut out for the time being to prevent confusion. Also any one station can speak to another, and it has been found that with an additional circuit made of 2 fuze pins (d) and a short piece of wire, the connection was much improved. Each of the 5 plates (b) is bored in the centre with a small hole to take these pins.

A line from (f) connects to the one instrument. A bayonet (we have plenty of Turkish ones) makes a good earth pin.

The arrangement is specially useful when Targets appear in the zones of observation of F.O.O. I, and F.O.O. II, which are invisible from the main Observing Station. F.O.O. is then connected with the Battery, and a gun or section placed under his direct control. The Battery Commander is able at the same time to check F.O.O.'s orders and control the fire.

Four lines connect main Observing Station with Battery. Two are always in use. Both these and one emergency wire are air lines. There is also one buried emergency wire 18" underground all the way. In the heaviest bombardment here we had only 3 of these lines laid and all were cut—two early in the battle, and the third about an hour afterwards. Communication was maintained by means of a short buried wire from Observing Station to a Signal Station whence orders were sent by lamp during the remainder of the night and by flag when it grew light. The Signal Station was exposed to a good deal of searching shrapnel and H.E. fire and the signallers displayed much coolness in getting the orders through. Recourse has since been had to this wire on one or two occasions. It is still in existence and forms a third reserve line.

Only one line at present connects each of the other stations to the Observing Station.

Battery Commanders Quarters are midway between Observing Station and Battery and both lines in use between these positions are tapped into by short lines communicating with a telephone box near his dug-out. From here by the exchange he is able to speak to any of the stations.

We find the old Stevens Telephone Instruments, with which we are provided, double the work and are a constant source of anxiety—as they invariably get out of order at critical moments. My advice is, stick to the "D" III. instruments, which we were robbed of at the last moment by fair means or foul.

## MAP READING.

BY MAJOR G. N. WYATT, R.A.

A few notes in amplification of *The Manual of Map Reading and Field Sketching*, 1912, to which any pages mentioned refer, may be of interest on account of the importance of this subject in every phase of warfare. After the mastery of a few conventional signs and the meaning of contours map-reading is only a matter of observation and commonsense, and this fact leads people to underestimate its difficulty and the need for continual practice. It is a good rule never to be without a map and pair of field glasses, especially when motoring or passing through new country. After a little time a district becomes so familiar that the dividing line between recognizing points by a study of the map and merely by knowledge of what they are is soon crossed, and the result may be disastrous when in a strange country. The writer recalls a day in Manchuria spent in taking photographs to prove that the map of Yang-tzu ling in the Official History of the Russo-Japanese war was wrong. After some hours it was gradually borne in upon him that the village reached after dark the previous night by a winding path among mountains was not the one that he imagined.

When finding the way by road time is an important factor not always taken into account. Thus "I must take the third turning to the right" will mislead if a new road has been made since the map was, but the addition of "in so many minutes (according to the pace)" will obviate that error. To save calculations when bicycling or motoring a time scale showing the number of miles likely to be travelled in so many minutes is useful. Distances on a bicycle without a speedometer can be accurately measured by fixing a stiff piece of paper between the spokes of the front wheel and listening to it clicking against the frame as the wheel revolves. Counting the revolutions becomes mechanical and need not distract the attention at all from the study of the surrounding country. On a 28" wheel 300 revolutions are equal to 700 yards. It is useful, to be able to measure distances approximately on a map without having to have recourse to a protractor which may get lost, or to the scale which may be folded away underneath the map. Individual finger measurements can easily be ascertained, e.g. little finger nail  $\frac{1}{2}$ ", middle joint of little finger 1", bottom joint of first finger 2", breadth of fingers fully extended 6", etc.

The correct description of roads and places on a map is very important and needs a lot of practice. The point where roads meet is often wrongly called "cross-roads", a term which only refers to the specific case of two roads crossing one another, i.e. of four roads meeting. "Road junction" is more often the correct term, or "forked

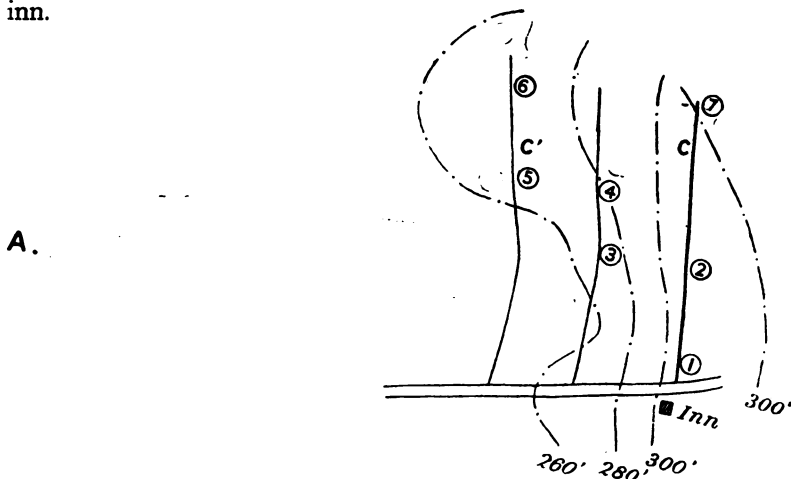
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roads" when two meet at rather an acute angle and coalesce into one. Places should be indicated by natural or artificial features if possible, e.g. "the knoll 400 yards east of Dayton railway station" rather than " $\frac{1}{4}$ -inch S.E. of the *N* in DAYTON." The former spot leaps to the eye at once when one arrives in its vicinity. The latter has to be searched for with measurement and calculation and then may be found wrong through DAYTON being printed in different places even on maps of the same date. To tell a Major to put his battery in a certain square of a map may lead to altercation with the occupant of a neighbouring square over an imaginary line on the ground. This would be avoided by giving a hedge, line of trees, etc. as the dividing line.

Setting a map by one of the methods on p. 43 should present little difficulty. Using the sun about midday will lead to error if it is not remembered that in every 4 minutes the sun appears to move  $1^\circ$ , so that at 11.30 or 12.30 it is not sufficient to direct the side of the map "roughly" at the sun, but at a point  $7^\circ$  or  $8^\circ$  away. The difference between local and sun time may also lead to a maximum error of  $4^\circ$ . The simplest method by directing a "ray" on to a known prominent point in the country may be spoilt by carelessness in fixing the observer's position. In England this can be done by observing the route traversed and measuring the distance moved at a certain angle from a neighbouring road; or perhaps a study of the immediate neighbourhood fixes the position without doubt. It is said that on many foreign maps this method is not sufficiently definite on account of the inaccuracy of the roads, and that absolute reliance can only be placed on churches and similar prominent points that have been used in survey work. Recourse must then be had to resection from three recognizable points, and a slight variation of the method on page 71 avoiding the triangle of error is preferable. On a piece of transparent paper place a dot to represent the required position, and keeping the paper fixed draw rays to three prominent points. The paper can be placed on the map in only one way so that the three rays pass through their respective points, and then the observer's position can be pricked through. Fine pencil work and rays intersecting at good angles are essential. In fixing a position by the immediate surroundings great attention should be paid to the shape of the ground which will not vary from that shown on the map except as the result of an earthquake or the expenditure of great quantities of high explosive. Roads may be made or ploughed up, woods cut down, houses built, and dependence on such features alone may result in identifying a position on the wrong side of a hill, in a valley instead of on a spur, etc. with disastrous results.

Though usually noticed in the immediate vicinity woods and buildings are often neglected when not so near and are a cause of problems involving visibility being incorrectly solved. From a point 200' high a hedge on a hill-side 2 miles away and at the same height will be visible if the highest intervening ground is a 200' ridge one mile away. But if on that ridge there are houses, say 40' high, the distant hedge must be one at a height of 280' to be visible. Some-

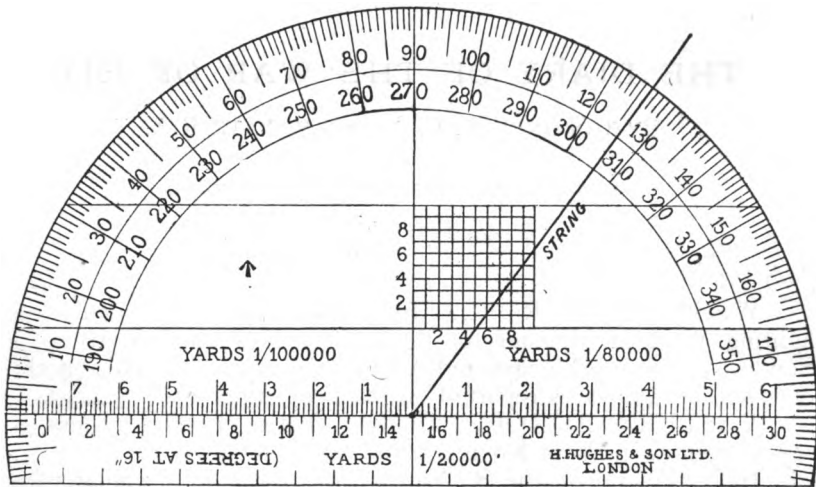
times a very careful calculation of heights and distances may be necessary to locate on the map a church partly visible over the top of a rise. No doubt these problems are much simplified by the help of a range-finder, and an eye for distance is a great asset to the map reader but very difficult to cultivate over undulating country parts of which are invisible. On large scale maps the relative slopes of ground need attention. What looks to be the third hedge from you on the ground need by no means be the third hedge on the map. A case in point is seen in the following representation of a real piece of country, A being at a height of 180' and distant about 2 miles from the inn.



Looking from A on the ground a straight hedge is visible running to the left from the inn. A casual observer would identify it as (1)—(7) on the map and give the range to a point C accordingly. As a matter of fact owing to the convexity of part of the ground the apparently straight hedge is made up of three (1)—(2), (3)—(4), and (5)—(6) each bit in turn disappearing behind the one in front of it, and the point C is in reality C', i.e. several hundred yards nearer.

When a point in the country has been identified on the map, reference to it will often save a lot of time and thought in identifying others. Lateral angles may be measured from it or other points noted as being in line, just to the right or left etc. The angles are measured best with a director, and laid off on the map with a celluloid protractor fitted with a string. A semi-circular one as in figure with degrees marked along the straight edge for a certain length of string enables both operations to be performed with the same instrument.

The numerous lines drawn across it make it very easy to place its edge parallel to one of the vertical lines on a map and so to measure bearings quickly when the angle between these latter lines and true North has been ascertained. If no line on the protractor quite suits, making a line on the map cut similar degrees on the protractor e.g.  $26^\circ$  and  $154^\circ$  gives the required result. The longitude is usually given on the top and bottom edges of a map and can be used for greater accuracy in preference to the North point in the



margin, but in a latitude of  $50^\circ$  the East and West margin will not differ by more than  $1^\circ$  in an extent of 60 miles.

On small scale maps cuttings and embankments are not shown, but they can often be inferred from the shape of the ground, by roads going under or over railways, etc., and hence covered ways for marching troops may be deduced. On these maps too the contours are at large vertical intervals and a very small bend in one denotes probably a marked spur or re-entrant. These features do not come to an untimely end with the contour that depicts them, but must be expected to continue for some way further. Bends in streams too suggest high ground barring the way and so causing the water to deflect. The power to estimate slopes by eye is very useful and comes with practice. The senior section commander entrusted with the selection of the actual battery position wants to know if the guns will clear the crest before he gets them up and instruments for measuring the slope may not always be handy. The straight edge of the circular protractor held perpendicular is a help, the string being held horizontal by the aid of an assistant standing to one side.

Much movement takes place now-a-days by night, and objects then appear so different to what they do by day that no study will take the place of actual practice. Marching on a compass bearing is not difficult given care and knowledge of the variation of the compass. But apart from that method it is very necessary to be able to recognize a few stars in different quarters of the heavens so as to be able to move roughly in the required direction even when the familiar Great Bear and North Star are clouded over. A chart of the heavens that can be set for the month and time of night, and a few starlit nights are all that are necessary to acquire this knowledge, plus the abandonment of a little sleep.



## THE DIARY OF THE WAR OF 1914.

BY COLONEL F. C. MORGAN, LATE R.A.

*(Continued from page 386).*

*July 22nd.*

WESTERN EUROPE.—In Alsace there has been violent fighting West of Munster for the past 3 days: and Metzeral and Sondernach have been captured from the enemy. Otherwise nothing of much importance is reported on the Western fronts.

EASTERN EUROPE.—In the Baltic provinces there was severe fighting S.W. of Kovno.

In N. Poland on the R. Narew front there were engagements. Warsaw is now threatened from the North, West, and South: and the Russian line of defence of the City extends from Blonie (W. of Warsaw), through Goza—Kalwaja and Iwangorod.

On the Lublin—Cholm front between the Vistula and the Bug rivers an important battle has been fought and on the Bug in Galicia, the fighting has been severe.

GALLIPOLI.—Sir Ian Hamilton reports a trench taken and an anti-aircraft gun destroyed in the Northern section, and also steady progress being made in the British section, whilst the French easily repulsed some Turkish attacks.

Paris reports calm on the front at the Dardanelles since the French successes of the 12th and 13th inst.

MESOPOTAMIA.—The Turks after their retirement on Nasiriyeh and Sukh-es-Sheyukh on the Euphrates River, strongly entrenched themselves: a force was consequently despatched by water and Sukh-es-Sheyukh was occupied with a loss to our side of 109 casualties: the enemy has now retired to a position near Nasiriyeh.

*July 23rd.*

WESTERN EUROPE.—In Artois near Souchez a violent cannonade and grenade fighting occurred, and also between the Oise and the Aisne and on the Champagne front. In the Argonne the French are making some progress.

EASTERN EUROPE.—The Russians have not been hindered in taking up their new position around Warsaw: and their line defending the Lublin—Cholm railway from Warsaw, has not yet been pierced.

The enemy continue their advance in Courland from Windau towards Riga.

ITALY.—Along the whole front of the Isonzo the battle continues, in favour apparently of the Italians.

An Austrian warship and 4 destroyers bombarded Ortona on the Adriatic and also the Tremiti Islands.

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*July 24th.*

WESTERN EUROPE.—The night of the 23/24th was calm on the whole French front except in the Vosges, where the enemy delivered several attacks N. of Munster and on the heights to the East of Metzeral, but were repulsed.

During the day there was artillery action around Souchez but nothing else to report took place.

EASTERN EUROPE.—The enemy are stated to have broken through between the fortresses of Roshan and Puliusk on the R. Narew, 30 to 40 miles N. of Warsaw. They are approaching the R. Bug from the North in the angle where the latter river joins the Narew.

ITALY.—The battle of the Carso is developing favourably for our ally owing to a concentration of 500 guns, the aim of the Austrians was to push back the entire Italian left across the R. Isonzo.

GALLIPOLI.—Sir Ian Hamilton reports an attack by the Turks on our trenches on the left flank of the Southern Section; the affair lasted only 20 minutes when the enemy retired.

NAVAL.—2 British submarines in the Sea of Marmora continue to considerably impede Turkish shipping: last week they sank 2 barques laden with ammunition, and afterwards entering the Golden Horn attacked and injured a destroyer moored at the quay. It is reported that the Turkish ship "*Breslau*" has been torpedoed in the Black Sea.

*July 25th.*

WESTERN EUROPE.—Sir John French reports that a bomb attack on the crater caused by the explosion of our mine west of Hooge was repulsed, and our heavy artillery silenced a large trench mortar assisting the attack.

On the 23rd a mine under a salient in the German lines S.E. of Zillebeke was exploded and the enemies trenches there were destroyed.

In the Vosges at the Ban de Sapt a fresh success was gained by the French, 700 unwounded prisoners and material being taken.

EASTERN EUROPE.—The Warsaw and Iwangorod fronts have been free from strong attacks; the enemies forces S. of Warsaw being concentrated on the Lublin—Cholm line of railway front.

ADEN.—The Press Bureau reports that Sheikh Othman has been reoccupied and is strongly held; it lies on the caravan route between Lahej and Aden: the Turks are still near Lahej 21 miles from Aden.

*July 26th.*

WESTERN EUROPE.—The French communiqué reports only artillery actions in the region of Souchez and also at Soissons.

Berlin states there have been no important events on the entire front.

EASTERN EUROPE.—Russian reports admit the crossing of the Narew by the enemy between the fortresses of Rozan and Puliusk, but their attempts about 20 miles North at Lomza were repulsed. This

advance towards the Bug menaces railway communication between Warsaw and Petrograd.

GALLIPOLI.—A despatch from a correspondent describes a battle on the 12th and 13th July, in which under almost insurmountable difficulties an attack from the left of the British front was completely successful, but not entirely so on the right.

ITALY.—The Italian naval forces have occupied the important island of Pelagosa in the Adriatic, and a French destroyer has wrecked the submarine and aeroplane supply station at Lagosta Island.

MESOPOTAMIA.—In continuation of the despatch of 22nd July it was announced in the House of Commons that the operations have been continued under the command of Major General G. F. Goringe who attacked the Turkish position at Nasiriyeh on the 24th July and occupied the town on the 25th, capturing 11 guns, 2 machine guns and several hundred prisoners; the enemy losing 500 killed, the British casualties being 3 to 400. General Nixon in forwarding the report states the operations were carried out in a temperature of 113 degrees Fahr, whilst the country is a net-work of marshes and canals.

*July 27th.*

WESTERN EUROPE.—In the Souchez sector there is a continuance of the fighting; the Crown Prince's attacks in the Argonne have been checked: and in Alsace the French have met with successes.

EASTERN EUROPE.—The enemies troops N. of Warsaw on the Narew front, are said to have been driven back between Rozan and Puliusk. The German version however states that a Russian attack E. of Rozan has failed.

In the Riga district the Russians are resisting the advance of the enemy from Windau, Shavli and the Dubissa and have repulsed with the aid of warships, a force advancing along the gulf towards Shlok a port 20 miles from Riga. On the Lublin—Cholm front S. of Warsaw, severe fighting has again commenced.

ITALY.—On the Carso plateau near the Isonzo, the Italians under General Cadorna have had successes: at Monte Busi the Austrian position and 3200 prisoners and war material were taken.

MISCELLANEOUS.—The prime-minister states that up to the 20th July the naval casualties amounted to 9,106, and the military up to July 18th, 321,889; making an aggregate of 330,995.

*July 28th.*

WESTERN EUROPE.—In Artois N. of Souchez German attacks at 3 different points during the night were thrown back. Soissons was bombarded. In the Argonne the enemies night attacks were also repulsed.

During the day no incident occurred from the Sea to the Vosges.

EASTERN EUROPE.—The Warsaw salient is being attacked on 3 sides: the enemy making progress on the N.E. along the R. Narew; on the S.W. on Lublin—Cholm front as far as the Bug the fighting continues, the enemy having been strongly reinforced.

**GALLIPOLI.**—The French report slight progress on their right wing, also a successful bombardment by airmen of the enemy's aviation camp N. of Chanak.

**NAVAL.**—The German submarines continue to destroy defenceless trawlers and merchant ships in the North Sea.

*July 29th.*

**WESTERN EUROPE.**—Sir J. French reports active mining operations on both sides, during the last few days in the neighbourhood of St. Eloi and Givenchy. A German aeroplane was shot down and fell near Zillebeke.

In Artois; the Argonne forest; and in the Vosges there was fighting during the night: but the day was fairly quiet on the whole front.

**EASTERN EUROPE.**—Owing to the enemy's overwhelming superiority in guns and munitions, the Russians are retiring to take up a new line, and refusing battle: the evacuation of Warsaw must shortly take place.

**AUSTRO-ITALIAN FRONTIER.**—Owing to the effectiveness of the Italian heavy artillery, our ally is able to make continuous forward progress, and their attacks on the Carso and Gorizia proceed satisfactorily.

*July 30th.*

**WESTERN EUROPE.**—Sir John French reports a bombardment of our trenches N. and S. of Hooze followed by an attack with "flame projectiles" which throw a liquid that ignites spontaneously from an ejector to a distance of 30 metres: the enemy succeeded in penetrating the first line of trenches on a front of 500 yards; the fighting is still in progress.

Artillery actions were violent in Belgium round St. Georges and Steenstraete; and also in Champagne. The French communiqué reports great activity on the part of aeroplanes, and notably a squadron of 45 left for the petrol-producing factories of Pechelbronn near Weissenburg as their objective, all returning safely.

**EASTERN EUROPE.**—Berlin reports the crossing of the Vistula between Warsaw and Iwangorod: also opposite the railway between Lublin and Cholm von Mackensen is said to have broken through the Russian line and to be astride the railway.

The Russians are preparing to abandon Warsaw together with the Polish quadrilateral of Iwangorod, Nowo Georgiewsk, Grodno, and Brest—Litowsk.

**ITALY.**—Austrian cruisers and torpedoes bombarded Pelagosa in the lower Adriatic and landed bluejackets under cover of the gun fire, who were driven back.

*July 31st.*

**WESTERN EUROPE.**—Sir John French reports further fighting near Hooze on the Ypres—Menin Road on 30th July, resulting in the recapture of the portion of the lost trenches W. of the village.

The chief feature of both French and German reports is the great activity on the part of airmen on both sides.

There was no infantry engagements on the French front to-day, but the customary artillery activity took place, in Artois; in the Argonne; and in the Vosges. 7 aeroplanes bombarded the station and Aviatak factories at Freiburg.

EASTERN EUROPE.—The German advance N. and S. of Warsaw continues, but on the Blonie lines W. of the city the Russians at present hold out.

ITALY.—The Austrians have withdrawn to a 2nd line of defence on part of the Isonzo front.

MISCELLANEOUS.—The Leyland liner "*Iberian*" was torpedoed and sunk by a German submarine.

*August 1st.*

WESTERN EUROPE.—Around Souchez the enemy attacked with hand grenades, but were easily repulsed and in Alsace they also attacked and sustained considerable losses. French aeroplanes dropped 30 bombs on the aviation camp of Dallheim. There was an artillery duel in Artois and in the valley of the Aisne.

EASTERN EUROPE.—The town of Lublin has been evacuated and between the Vistula and the Bug the Russians retired on positions previously prepared. The Lublin—Cholm line has been completely given up.

*August 2nd.*

WESTERN EUROPE.—There were infantry engagements at various points, and the enemy were repulsed in the Argonne. On the Heights of the Meuse; and in Artois: near Souchez the battle was continued with hand grenades and petards.

EASTERN EUROPE.—Unimportant changes have taken place in Poland: but the enemy have reached Mitau S.W. of Riga. The Russians' orderly retirement have necessitated heavy rearguard actions.

ITALY.—The enemy sustained a reverse in Eastern Carnia: and Italy is resuming the offensive in the Trentino.

NAVAL.—A British submarine reports the sinking of a German Destroyer of the G./196 class on the 26th July near the German Coast. In the sea of Marmora a steamer of 3000 tons was torpedoed and other smaller craft fired at by British torpedoes.

MISCELLANEOUS.—A war office official in a Prize Court case stated there were 4,000,000 Germans under arms and 750,000 in training: 3¼ millions being employed in railway work, munition factories, coal mines and other industries.

*August 3rd.*

WESTERN EUROPE.—There was less artillery activity along the front and nothing of importance occurred.

EASTERN EUROPE.—On the Narew the enemy are slowly advancing but incurring severe losses: the Russians are retiring towards Riga. On the Lublin front in the South the enemy have

been repulsed. Russian reports state that from the Baltic to the Bukowina they have to face 35 German army corps of which 13 have come from the West. It is stated that Russia has put between 6 and 7 millions of men into the field since the commencement of the war and that as many more are available for training: the output of arms and munitions is steadily increasing and when full requirements are met, Russia will give decisive battle to the invader.

GALLIPOLI.—Sir I. Hamilton reports a successful attack from the position held by the Australian and New Zealand corps: the Turks did not counter-attack and 70 were killed: the position of the line was improved.

*August 4th.*

WESTERN EUROPE.—There were artillery attacks in the Steenstraate—Hetsas sector in Belgium, also in Artois and between the Somme and the Oise, and in the Argonne forest; otherwise the day was quiet.

EASTERN EUROPE.—The enemy claim to have forced the Blonie line, the western defence of Warsaw, and also the Narew near Ostroleka N. of Warsaw and to have defeated the Russians opposing Von Mackensen's army in the South: our ally publishes on the other hand an optimistic report.

ITALY.—The Italians are concerting measures for naval and military co-operation in the Dardanelles.

*August 5th.*

WESTERN EUROPE.—Fighting continues in Artois, around Souchez, and unimportant attacks in other parts of the line; but in the Vosges serious actions occurred where curtains of shrapnel inflicted heavy losses on the enemy.

EASTERN EUROPE.—Warsaw was occupied by the Germans to-day, the enemy reporting tenacious resistance on the part of the Russians in the outer and inner line of forts: the enemy have also made further progress N.W. and S. of Warsaw. Prince Leopold brother of the king of Bavaria conducted the final assault on the city.

ITALY.—The railway station at Borgo 17 miles E. of Trent was shelled by an effective artillery fire.

GALLIPOLI.—The positions occupied by the Australian and New Zealand troops remain the same, except towards the N. where an advanced post some 2000 yards has been thrown out, and the Colonials have made their fire trenches comparatively impregnable.

MISCELLANEOUS.—The King has approved of the award of Distinguished Conduct Medals to more than 400 Warrant, N.C. officers and men for acts of gallantry and devotion to duty while serving with the Expeditionary Forces in France and Flanders, in Turkey in Asia, and at the Dardanelles.

*August 6th.*

WESTERN EUROPE.—In Artois and in the Argonne fighting went on throughout the night.

In the daytime in these districts artillery actions took place. In the Vosges there was quiet.

**EASTERN EUROPE.**—The Russians who defended Warsaw blew up all the bridges over the Vistula on retiring. The fortress of Iwangorod has been evacuated, and Vilna on the railway line of communications between Warsaw and Petrograd is now threatened.

**GALLIPOLI.**—There have been no striking facts to report since the beginning of August. Intermittent artillery attacks have taken place and activity among the aircraft. General Sarraill has been appointed C-in-C. of the French army in the East.

*August 7th.*

**WESTERN EUROPE.**—A few encounters occurred around Souchez during the night and in the Western Argonne there was lively fighting with petards and bombs, the Germans renewing their attacks on Hill 213, which were unsuccessful.

**EASTERN EUROPE.**—The enemy's advance in the E. is hotly pressed, but the order of the Russian retreat is unbroken. Near Riga the Germans have been driven back, and are now 20 miles from the town.

**ITALY.**—In the Plava sector the conquered positions are being strengthened, and there has been stubborn fighting on the Carso. An Italian airship flying above Pola was brought down by Austrian fire and the crew made prisoners.

*August 8th.*

**WESTERN EUROPE.**—In the Vosges there was a violent German attack which was repulsed with serious losses to the enemy, in one part 100 German corpses were hung up on the barbed wire entanglements. Artillery actions took place in Belgium in the Steenstraete—Hetsas sector, in Artois and in the valley of the Aisne, where Soissons was bombarded. In the Woevre, there was artillery activity.

**EASTERN EUROPE.**—On the Narew the enemy continues vigorous attacks against the Lomza—Ostrow sector. Further South there have been obstinate rear-guard actions.

*August 9th.*

**WESTERN EUROPE.**—Sir John French reports that since the 1st August the artillery on both sides have been active N. and E. of Ypres, the advantage being with us. On this date the trenches at Hooge which were captured by the enemy on the 30th July were retaken extending the front captured to 1200 yards: at the same time a German train at Langemarck was de-railed and set on fire.

Reims has been again bombarded and artillery actions took place in the Vosges. 32 bombardment aeroplanes, escorted by others for pursuit purposes left to bombard Saarbrecken, 38 miles E. of Metz, 28 of them reached the goal and dropped 164 shell.

**EASTERN EUROPE.**—The enemy has renewed his attacks on the fortifications of Kovno; and near Ossovetz and in the district of Jedwabno there has been violent cannonading, also isolated fighting on the left bank of the Narew. The fortress of Nowo-Georgiewsk is said to be now cut off. The most northerly wing of the German army has been checked S. of Riga.

**GALLIPOLI.**—The Turkish battleship "*Hairred-in-Barbarosse*" has been sunk by a British submarine.

*August 11th.*

**WESTERN EUROPE.**—Sir John French reports that N.W. of Hooge and in the ruins of the village the ground gained has been consolidated and a night infantry attack repulsed; in the afternoon of the 10th a violent artillery engagement took place, which made the trenches untenable to either side and a slight withdrawal of the British line took place.

In Artois the Germans attacked with petards but were thrown back, and in the Argonne, Bois-le-Prêtre, and in Lorraine fighting took place.

**EASTERN EUROPE.**—At the entrance of the Gulf of Riga, a German fleet of 9 battleships 12 cruisers, and many destroyers were driven off.

**GALLIPOLI.**—Sir Ian Hamilton reports a new landing elsewhere in this region: fighting at several points has taken place, and substantial progress has been made, 630 prisoners and machine guns and mortars having been captured.

**ITALY.**—The general situation is unchanged.

**AIRCRAFT.**—A squadron of hostile airships visited the E. coast on the night of the 9/10th August: the casualties were 9 killed and 14 wounded, incendiary bombs causing fires. One Zeppelin was seriously damaged by gun fire from the land defences and on being towed into Ostend was completely destroyed by aircraft from Dunkirk, this is the 3rd Zeppelin that has been destroyed or badly damaged after a raid on our coasts.

**NAVAL.**—H.M.S. "*Lynx*" (Destroyer) struck a mine in the North Sea and sank on the 9th, 4 officers and 22 men were saved.

*August 12th.*

**WESTERN EUROPE.**—In Artois and the Argonne there were artillery engagements during the night: near Souchez German attacks were driven off.

**EASTERN EUROPE.**—The fortress of Kovno is being violently attacked with guns of 16-in. calibre.

On the Riga roads the enemy's attacks on the River Eckau have been repulsed.

Near Novo Georgiewsk the German attack on the southern fortifications was driven back.

**GALLIPOLI.**—The latest report states that the area held at Anzac has been nearly trebled, chiefly owing to the gallantry of the



Australian and New Zealand Army Corps: to the North no further progress has been made. The French battleship "*St. Louis*" is said to have put out of action 5 out of 6 guns in Asiatic batteries.

ITALY.—An Austrian submarine U 12 was torpedoed and sunk by an Italian submarine in the Upper Adriatic.

NAVAL.—H.M.S. "*Ramsey*" a small armed patrol vessel was sunk by the German armed auxiliary steamer "*Meteor*" on 8th August in the North Sea, 4 officers and 39 men were saved. A squadron of British cruisers having sighted the "*Meteor*", the latter's Captain abandoned the ship and blew her up. On 9th August a British submarine sank the Turkish battleship "*Hairred-in-Barbarosse*" 5 miles from Gallipoli.

*August 13th.*

WESTERN EUROPE.—In Artois about Souchez and the Bois-le-Prêtre there has been trench fighting; also attacks on the part of the enemy were made in Argonne and in the Vosges.

EASTERN EUROPE.—The Germans advance steadily from Ostroleka in the N. to Cholm in the South, their progress due East from Warsaw being more rapid than that of their flanks. Their efforts against Kovno have hitherto been unsuccessful.

ITALY.—The enemy's attacks on the N.W. frontier of the Trentino below the Ortler failed. In Cadore slight engagements occurred.

GALLIPOLI.—From Constantinople the enemy report having repulsed 4 hostile attacks.

NAVAL.—H.M.S. Auxiliary Cruiser "*India*" whilst on patrol duty in the North Sea on the 8th August was torpedoed by a German submarine and sunk, 22 officers and 119 men were saved.

A British submarine sank a Turkish battleship on the morning of 8th August at the entrance to the Sea of Marmora: a gunboat and an empty transport were also torpedoed by a British submarine: the latter afterwards shelled a column of troops marching towards Gallipoli.

*August 14th.*

WESTERN EUROPE.—Again there is little news from the West. In the Argonne German attacks have met with no success.

EASTERN EUROPE.—Berlin announces that their attacking troops before Kovno have made progress; but the Russians report a severe repulse to the enemy. Von Mackensen in the South has met with obstacles to his advance. In the centre the enemy have taken Szidlee 60 miles E. of Warsaw and are close to the River Bug.

From Petrograd it is reported that the enemy in great force approached the entrance to the Gulf of Riga and the Aland Islands, but were driven off by warships and the shore batteries.

ITALY (NAVAL).—In the lower Adriatic the Austrian submarine U 3 was sunk, and another U boat was destroyed.

**AIRCRAFT.**—Two Zeppelins visited the E. Coast between 9.30 and 11.45 p.m., they dropped incendiary and explosive bombs at various places, killing 6 and injuring 23 men, women and children. It is probable that one was damaged by the mobile anti-aircraft section.

*August 15th.*

**WESTERN EUROPE.**—Violent artillery actions took place during the night in Artois (sector of Souchez and Roelincourt), in Champagne (the Beauséjour Redoubt), and in Lorraine.

19 aeroplanes (French) bombarded a German park and dépôt in the Meuse—St. Mihiel region.

**EASTERN EUROPE.**—The Russians report repulse of 4 German attacks on the Western defences of Kovno: on the other hand the enemy states that a Russian sortie from the fortress was driven back, with the capture of 1000 prisoners.

**AUSTRO—SERBIAN FRONTIER.**—Renewed activity has taken place in this region and Belgrade has been again bombarded.

**ITALY.**—In the valley of the Adige at Serravalle and on the plateau N.W. of Arsiero, and also in the valley of Sapena and of Sexten there has been fighting; but of not much importance as regards results on either side.

*August 16th.*

**WESTERN EUROPE.**—During the day there were violent artillery duels along the front: and last night intermittent cannonading took place in the region of Souchez and on the plateau of Nouvron N. of the Aisne.

**EASTERN EUROPE.**—The enemy claim to have broken the Russian centre at Bransk. Prince Leopold of Bavaria and von Mackensen are closing in on Brest—Litowsk from the W. and S.W.

In the North Kovno still holds out against vigorous attacks.

**GALLIPOLI.**—Vice Admiral J. M. de Robeck's despatch d/d 1st July is published to-day reporting the landing of the Army on the Gallipoli Peninsula 25/26th April, 1915: 6 Victoria Crosses have been awarded for conspicuous acts of bravery mentioned in the despatch.

**MISCELLANEOUS.**—A German submarine to-day fired several shells at Parton, Harrington, and Whitehaven on the Cumberland coast between 4.30 a.m. and 5.20 a.m.: no material damage was caused.

*August 17th.*

**WESTERN EUROPE.**—An enemy's attack in the Argonne was again repulsed: and after a heavy bombardment the French made a successful attack in the Vosges.

**EASTERN EUROPE.**—The fortresses of Kovno and Nowo Georgiewsk still hold out: the latter is isolated being 80 miles W. of

the German advance; whilst Kovno protects the passage of the Niemen and is 40 miles W. of the railway junction of Vilna.

W. AFRICA.—Garna in the Cameroons is reported to have surrendered on the 10th June to a force of French and British troops.

ITALY.—In the Monte Nero and Tolmino district, the Italians have vigorously resumed the offensive and have captured 17 officers 547 men and 4 machine guns.

NAVAL.—The Transport "*Royal Edward*" was sunk in the Ægean Sea by an enemy submarine on the 14th August: those on board numbered over 1600, of whom about 600 were saved. The troops consisted of drafts for the 29th Division and of the R.A. Medical Corps.

*August 18th.*

WESTERN EUROPE.—Sir John French reports no incidents since his communiqué of the 10th August, when the position recaptured at Hooge had been consolidated: subsequently artillery engagements of an intermittent nature only, have occurred on the remainder of the front.

The French communiqué reports that since the 8th August the Germans have gained no ground, in spite of their assertions to the contrary; and on the whole front the French troops preserve their ascendancy over the enemy in daily duels, and in fighting at close quarters, with bombs and grenades.

EASTERN EUROPE.—The Germans claim to have taken Kovno by storm on the 17th August, with all its forts and vast quantities of war material, including more than 400 guns, but only after a most stubborn resistance. The hold of the Russians on the whole Niemen line now becomes insecure.

Von Mackensen has driven the Russian army beneath the shelter of the outer works of Brest-Litowsk.

GALLIPOLI.—Sir Ian Hamilton reports the situation unchanged during the 14th and 15th when the Australian and New Zealand Army Corps' position was attacked heavily by the Turks, who were repulsed. The troops on the left flank advanced on the 15th and gained about 500 yards.

AIRCRAFT.—Zeppelins visited the Eastern Counties on the 18th and dropped bombs—anti-aircraft guns were in action and one Zeppelin was believed to have been hit: 10 people were killed and 36 injured: also buildings and a church were damaged: atmospheric conditions were favourable to the escape of the airships.

*August 19th.*

WESTERN EUROPE.—The French achieved 2 successes N.W. of Souchez, and gained the junction of the Bethune—Arras and Ablain—Aeyres roads: in the Vosges they gained a trench on the Linge summit.

EASTERN EUROPE.—The fall of Kovno to the enemy has been confirmed, but on the front from Riga to Janow (N.E. of Kovno) there was no essential change.

At Nowo Georgiewsk the enemy has been attacking with vigour the forts on the Right bank of the Vistula, and on the Narew.

GALLIPOLI.—Recent operations on the peninsula have consisted of attacks on the enemies positions along the Southern and Anzac lines and included a fresh landing at Suvla Bay; the fighting was severe and on both sides the casualties were very heavy: the enemy brought up considerable reinforcements when the further advance of our troops was brought to a standstill.

MISCELLANEOUS.—The allied governments have agreed that cotton shall be considered as contraband of war. The White Star liner "*Arabic*" which sailed from Liverpool to New York on the 18th inst. with 181 passengers and 232 crew on board, was torpedoed and sunk without warning by a German submarine at 9.30 on the 19th—391 persons were saved.

*August 20th.*

WESTERN EUROPE.—During the last few days the calm in the Ypres section has been broken by some violent shelling: and on the 17th a German aeroplane was brought down by our guns near Warneton.

The enemy succeeded in regaining a footing in the trenches captured by the French yesterday, but sustained heavy losses.

EASTERN EUROPE.—A large German Naval force engaged a Russian squadron at the entrance of the Gulf of Riga and the fight is proceeding: Nowo-Georgiewsk has fallen to the enemy together with 20,000 Russian prisoners: Von Mackensen in the South is steadily approaching Brest—Litowsk.

NAVAL.—A British submarine E 13. (Lt. Commdr. Layton) on its way to the Baltic, grounded off the island of Saltholm in the Sound, near Copenhagen, 15 of the crew are missing out of 30

*August 21st.*

WESTERN EUROPE.—German attacks in Artois and the Vosges were repulsed, and artillery activity at many points on the front occurred: Reims was again bombarded.

EASTERN EUROPE.—The Russian land front remains firm in the region of Riga, and no important changes have taken place on the whole of the front.

AIRCRAFT.—Flight Lieutenant Edmonds from a seaplane in the Dardanelles dropped a heavy bomb on the deck of a Turkish transport on 12th August, sinking the ship and causing the loss of all the troops on board.

NAVAL.—Lt. Commander Layton reports that E. 13 submarine which grounded off Denmark on the 19th August, was torpedoed whilst aground; her crew when in the water, being fired on by machine guns from a German Destroyer.

*August 22nd.*

WESTERN EUROPE.—A German attack in the Vosges was completely repulsed, and in the Argonne and the Woivre district

there were bomb and grenade actions and fighting with trench appliances.

**EASTERN EUROPE.**—The German attempt to force an entrance into the Gulf of Riga has failed up to the present: and Russian warships combined with British submarines and the land defences have inflicted a severe reverse on the enemy, the German warship "*Moltke*" being sunk: this ship together with others carried out the raid on Yarmouth and Lowestoft on November 3rd, and on Scarborough in December, and was also in the battle of the Dogger bank on 24th January.

**ITALY.**—The Italian Government has declared war on Turkey for the 2nd time within 4 years.

*August 23rd.*

**WESTERN EUROPE.**—The efforts of the French in the Vosges have led to progress, and successful fighting has taken place on the crests of the Linge and the Barrenkapf after effective artillery preparation. 2 French torpedo boats sank a German Destroyer off Ostend, and the allied warships have bombarded Zeebrugge. Belgian aircraft have successfully bombarded German establishments and positions in the Houthulst Forest.

**EASTERN EUROPE.**—Ossovetz fortress situated on the Bobz, N.W. of Bialystok has fallen to the enemy, who have also made further progress E. of Kovno.

*August 24th.*

**WESTERN EUROPE.**—There were artillery actions in the night in the sector N. of Arras: and during the day marked artillery activity on both sides in Belgium, in Artois, and between the Somme and the Oise. A squadron of 7 aeroplanes bombed Tergnier and Noyon stations on the night of the 23rd all returning safely to our front.

**EASTERN EUROPE.**—The fortress of Ossovetz has been abandoned and the Russians are retiring from their positions on the Niemen and the Bobz.

S.E. of Kovno there has been heavy fighting, and the German advance is strongly resisted.

**NAVAL.**—The allied fleet on the 23rd bombarded the Belgian coast batteries off Zeebrugge.

*August 25th.*

**WESTERN EUROPE.**—From France it is announced that the British front has been considerably extended, British batteries having replaced the French at many points. On the whole of the front there have been artillery actions, and most violent in the sector to the N. of Arras, between the Somme and the Oise, in Champagne, in the Argonne, and in the Bois le Prêtre. A French airman bombarded the railway station of Lörrach in Baden.

**EASTERN EUROPE.**—There is nothing of importance to note.

**GALLIPOLI.**—The operations which have been in progress since 6th August on the Western extremity of the Peninsula, consisted of 2 separate lines of attack, the first from the old Anzac position by the Australian and New Zealand troops, and the second from the new landing at Suvla Bay by a fresh army: an attack was also made in conjunction, from Cape Helles towards Krithia. Our troops although they have not gained the objectives aimed at, have increased the area in our possession.

**BALKAN STATES.**—A new Austro-German offensive against Serbia is said to have been planned, involving also a violation of Bulgarian territory.

*August 26th.*

**WESTERN EUROPE.**—62 French airmen took part in an air raid, dropping bombs on the Dillingen ironworks, a shell and armour plate factory in the Rhine province N. of Saarlouis; and another raid of 60 British, French and Belgian airmen attacked the forest of Houthulst N.E. of Ypres: all the aeroplanes returned safely. The enemy again bombarded Reims and there were artillery actions around Souchez and in the valley of the Aisne.

**EASTERN EUROPE.**—The fortress of Brest Litowsk has fallen to the enemy, this being the 4th of the Polish Quadrilateral, consisting also of Warsaw, Iwangorod, and Nowo Georgiewsk. Brest was the real base of the Russian operations in Poland.

**NAVAL.**—A German submarine was destroyed off Ostend by bombs dropped from an aeroplane under Sq. Comdr. A. W. Bigsworth, R.N.

*August 27th.*

**WESTERN EUROPE.**—On the night of the 26th a French airman dropped 10 bombs on the asphyxiating gas factory at Dornach, and to-day a squadron of aircraft bombarded the electrical station at Mülheim in Baden. The French artillery effectively bombarded several German positions.

**EASTERN EUROPE.**—From Russia it is officially reported that the decision in the campaign cannot come before next year, but meanwhile everything is ready for the winter and Petrograd is safe. There is no change in the Riga region, nor towards Vilna or in Galicia.

*August 28th.*

**WESTERN EUROPE.**—Artillery actions took place round Souchez and Neuville, in the region of Roge and in the forest of Argonne.

6 German aeroplanes attempted a flight in the direction of Paris they dropped bombs at various places; one machine was brought down by a French airman from a height of 11,700 ft.

**EASTERN EUROPE.**—The Germans continue their advance in the East and have broken through the Russian positions on the Zlota-Lipa.

A fresh invasion of Serbia towards Nish is contemplated and a massing of troops is taking place on the N.W. Frontier of Roumania.

*August 29th.*

WESTERN EUROPE.—The French artillery continued during the night its action against the enemies positions; and airmen dropped bombs on the railway station and hutments of the enemy at Grand Pré, and also in the Argonne.

EASTERN EUROPE.—The enemy have pressed N.E. of Brest Litowsk and driven back the Russians to near Kobryn: their progress being specially marked E. of Kovno.

*August 30th.*

WESTERN EUROPE.—Sir John French reports there has been no fighting on the British front to record since the 18th August; but there has been a certain amount of mining activity: conditions generally have been normal.

On the 18th and 21st enemy aeroplanes were shot down, and on the 25th the British Heavy Artillery set fire to a railway train at Langemark; also on the same evening the R.F.C. made an aerial attack on the forest of Houthurst.

In the Argonne an artillery struggle accompanied by mine explosions and bomb and grenade fighting took place, and there was a lively cannonade in Lorraine as well as in the Vosges.

EASTERN EUROPE.—The enemy stormed Lipsk on the Bobr 20 miles west of Grovno the last important fortress on the Russian front. East of Kovno a steady advance is being made towards Vilna an important railway junction. In the South Von Mackensen is said to have defeated the Russians in a rear-guard action among the marshes S. of Kobria.

ITALY.—The Italian offensive is being pressed in the Val Sugana on the Eastern side of Trent and on the Isonzo front.

*August 31st.*

WESTERN EUROPE.—A constant bombardment is taking place of the whole of the German lines on the West front. Berlin reports that no important events have taken place. In the air raids of last week a large hangar at Ghent was destroyed.

EASTERN EUROPE.—There is heavy fighting for the possession of the railway between Riga and Dvinsk and the enemy are endeavouring to cut off the Russian troops still at Vilna and Grodno. In the South a movement is being made against the trunk line between Kovel and Kieff in order to isolate the Russians in Galicia.

*September 1st.*

WESTERN EUROPE.—There was again artillery activity on the western front, and an unsuccessful attack was made by the enemy on the French positions in the Vosges.

**EASTERN EUROPE.**—A Russian success in East Galicia resulted in the capture of 30 guns and 3000 prisoners: further N. at Lutsk heavy losses were inflicted on the enemy, 10 officers and 7000 men being captured. Vilna is still in Russian hands and in the neighbourhood of Grodno the enemies' advance has been checked.

**GALLIPOLI.**—On the 27th and 28th August an important tactical feature of ground commanding the Biyuk Anafarta Valley, was captured, an appreciable gain in the area occupied by the Australian and New Zealand Army Corps: a considerable quantity of material was captured.

*September 2nd.*

**WESTERN EUROPE.**—In the Artois, the Argonne and at Vosges, the heavy artillery fighting continues.

**EASTERN EUROPE.**—The Russians are holding their own and in some places passing to the offensive. A Berlin despatch however reports that the outer line of forts of Grodno have fallen.

**ITALY.**—Vienna reports the positions as unchanged: our ally mentions artillery actions and minor trench warfare.

**GALLIPOLI.**—The battle in the Peninsula, after the landing at Suvla Bay lasted 4 days and nights, under difficulties of climate, position, and supply.

**NAVAL.**—Four Turkish transports have been sunk by British submarines in the Dardanelles.

*September 3rd.*

**WESTERN EUROPE.**—In the course of the night the usual artillery activity occurred without any notable incident.

**EASTERN EUROPE.**—The fortress of Grodno has fallen, but apparently the Russians made no real defence, holding it merely to cover the retreat of their troops.

On the railway connecting Grodno with Vilna in the Orany district a stubborn fight took place, the Germans claiming a victory.

*September 4th.*

**WESTERN EUROPE.**—In Champagne and in the Argonne western border, bomb and grenade fighting occurred: and a continuation of artillery fighting in Artois and to the N. of the Aisne.

**EASTERN EUROPE.**—Von Hindenburg has forced the bridge head of Friedrichstadt on the River Dvina; where there has been heavy fighting for the crossing lasting several days: the bombardment of the enemy finally compelling our ally to withdraw to the Right bank of the river on the 3rd inst. The bridge-head at Lennewaden nearer to Riga was also taken.

**MISCELLANEOUS.**—France officially reports casualties to German officers as amounting to 52,041, up to the 15th July.

General Alexis Evert has been appointed Commander-in-Chief of the Russian armies, in succession to General Alexeieff.



*September 5th.*

WESTERN EUROPE.—For more than a fortnight there have been no infantry actions, except in the Vosges; but heavy bombardments by the Allies have occurred, on the Belgian front, and at numerous points along the whole line.

EASTERN EUROPE.—The railway line between Jacobstadt and Riga is now threatened by the enemy: and the communications with Riga from Dvinsk and Vilna may be cut off.

GALLIPOLI.—Since the end of August, all has been quiet in the Southern zone of the Peninsula: in the Northern portion after several lively engagements progress has been made by the British troops.

NAVAL.—The Secretary of the Admiralty states that the loss of German submarines has been "formidable."

*September 6th.*

WESTERN EUROPE.—Artillery actions continued along the whole front; and in the Vosges at Hartmannsweilerkopf, there was fighting with heavy bombs.

40 French aeroplanes bombarded the station, factories and military establishments at Saarbrücken, with considerable effect. Aircraft also bombarded the barracks at Dieuze in Alsace.

EASTERN EUROPE.—The Russian munition crisis has now been relieved, and our ally is able to assume the counter-offensive.

In the Black Sea, 2 Russian Destroyers attacked the cruiser "*Hamidieh*" and 2 Turkish torpedo boats; after an action of 2 hours the enemy fled to the Bosphorus, and 4 colliers which they left were sunk.

ITALY.—Frequent active reconnaissances of troops lead to encounters with the enemy's detachments, who are said to retire owing to the resolute conduct of our ally.

*September 7th.*

WESTERN EUROPE.—The French artillery in the region of Nieuport co-operated in the bombardment by the British Fleet of the German coast batteries at Westende.

A violent cannonade N. and S. of Arras took place, also in the Argonne and other areas. French aeroplanes have been actively engaged in bomb-dropping.

The Belgians report violent bombardment of their positions around Dixmude.

EASTERN EUROPE.—There has been some check to the rapid advance of the enemy into Russia. The Czar of Russia has appointed himself to the supreme command of the army and navy, in place of the Grand Duke Nicolas.

GALLIPOLI.—Hard fighting is proceeding on the front, war-ships being also engaged: and progress has been made on the Suvla front.

NAVAL.—The German submarine U 27 is reported as lost; she in all probably was responsible for the sinking of the auxiliary cruiser "*India*" on the 8th August.

AIRCRAFT.—3 Zeppelins visited the Eastern counties on the night of 7/8th, and bombs were dropped; anti-aircraft guns were in action but failed to locate the airships: fires occurred and damage to several houses, causing 56 casualties, including 13 killed.

*September 8th.*

WESTERN EUROPE.—There were artillery actions in Belgium, N. of Ypres, in Artois, around Arras and on the plateau between the Oise and Aisne. In the Argonne after a violent bombardment, on the 7th, a sustained attack of 2 Infantry Divisions was made by the enemy, who though gaining a footing at some points, failed to break the front of our ally.

EASTERN EUROPE.—There has been no change in the Riga district. S. of Friedrichstadt 42 miles from Riga, the attacks delivered by the enemy since the 5th and 6th September, have been all repulsed. On the middle Niemen the enemy developed his operations from Grodno towards the East, and further South at Volkovysk the Russian rear-guards sustained a stubborn fight. On the railway at Kovel the Russian cavalry made successful dashing charges. In the Tarnopol district fruitless attempts were made by the enemy to take the offensive.

AIRCRAFT.—Allied airmen bombarded Ostend, dropping 60 shells on the aviation ground at St. Medard and on the railway station at Dieuze. On the night of 8/9th, hostile aircraft raided the Eastern Counties and the London district, dropping incendiary and explosive bombs.

*September 10th.*

WESTERN EUROPE.—In the Vosges the enemy attacked French positions firing asphyxiating shells, but a 1st line trench which had to be evacuated owing to the squirting of blazing liquids, was recaptured. The enemy also attacked on the trenches on the summit of the Hartmannsweilerkopf, and after gaining a footing, were counter-attacked and hurled back to their lines. 30 shells were dropped on the railway station of the enemy at Grand Pré, in the Argonne. In Belgium in the districts of Nieupoort and Steenstraate, in the Arras area and in Champagne there was lively cannonading.

EASTERN EUROPE.—The offensive in Galicia has passed into Russian hands and S.W. of Trembowka on the 7th September they captured 7000 prisoners and some guns. In the North Von Mackensen is advancing towards Kovno and now holds Dubno. In the North central part of the front, no decisive result has been obtained, but there has been fierce fighting.

ITALY.—Small but important actions continue along the whole front.

MISCELLANEOUS.—The decoration of the Legion of Honour was bestowed on 11 British officers by the President of the French Republic.

*September 11th.*

WESTERN EUROPE.—An uninterrupted cannonade took place during the night in the areas N. and S. of Arras; also violent artillery duels E. of Les Eparges and in Lorraine. There were no infantry actions, only intermittent firing along the whole Belgian front.

EASTERN EUROPE.—Von Hindenburg is massing forces in the North for another attempt to capture the Warsaw—Petrograd railway, between Vilna and Dvinsk.

*September 12th.*

WESTERN EUROPE.—Berlin states that no damage was caused by the recent bombardment of the aviation sheds at Ostend.

Bomb and grenade fighting accompanied by cannonading on both sides occurred N. of Arras and in the sector Neuville. French aeroplanes effectively bombarded the aviation sheds at Brayelle.

EASTERN EUROPE.—In the Tarnopol district in Galicia, the fighting has been favourable to the Russians. In the Pinsk district, 200 miles E. of Warsaw there is no change. In the Rovno region further S. the enemy is continuing his offensive.

AIRCRAFT.—A raid on the E. coast was attempted by Zeppelins on the night of 11/12th: bombs were dropped, but there were no casualties, and no damage caused.

GALLIPOLI.—There has been quiet during the last 5 days. In the Northern zone the Turks opened a violent artillery fire, without leaving their trenches. In the Southern zone, effective use was made of trench mortars.

*September 13th.*

WESTERN EUROPE.—There were artillery actions and bomb fights in Champagne, in the Argonne, and between the Meuse and the Moselle. A French squadron of 19 aeroplanes flew over Treves, dropping 100 shells, they also bombed the station of Dommery Baroncourt.

EASTERN EUROPE.—In the Riga district there were small encounters of troops only: the town is said to be in an excellent position for defence: and the R. Dwina is broad there and flooded by rains.

The enemy strongly reinforced is attacking the Dvinsk—Vilna line in 3 directions. In Galicia the Russians inflicted a reverse on the enemy at Tarnopol, and also on the Sereth.

AIRCRAFT.—The East Coast was again raided by hostile aircraft on 12/13th September: but there were no casualties and only small damage done: a hostile aeroplane also visited the Kentish Coast

on 13th, one house was damaged by bombs and 4 persons injured : the enemy was chased off by 2 naval aeroplanes.

Admiral Sir P. M. Scott, K.C.B., &c. takes charge of the gunnery defences of London against aircraft.

*September 14th.*

WESTERN EUROPE.—Artillery duels continue round Arras and on the Champagne front, as well as on the Belgian front.

New guns are said to have been mounted at Zeebrugge, to replace those destroyed by British warships. 2 German aeroplanes were brought down in the British lines on the 13th.

EASTERN EUROPE.—There is no change in the Riga and Friedrichstadt districts : but the Vilna—Petrograd railway has been cut by the enemy near Suenziany, and the Russians have had to yield ground to the S. of Grodno. In Galicia the Austrian troops have been driven back.

GALLIPOLI.—The fire of the batteries on the Asiatic side of the Dardanelles has slackened greatly.

AIRCRAFT.—A Zeppelin again visited the East Coast on the night of the 13/14th when bombs were dropped. Fixed and mobile anti-aircraft guns were in action : there were no casualties and no damage reported.

*September 15th.*

WESTERN EUROPE.—Sir John French reports no change in the situation on the British front since 9th of September. Artillery has been active S.E. of Armentières and in the neighbourhood of Ypres. During the past week there have been 21 air fights over the German lines and in 11 cases the enemy's aeroplanes were driven to the ground. There have been gun actions in Artois, on the Aisne Canal, and on the heights of the Meuse.

EASTERN EUROPE.—The Russian victories in Galicia are affecting the situation farther North : Von Mackensen has been checked N.W. of Rovno, and the German advance on Vilna is being resisted. Petrograd states, that 40,000 enemy prisoners have been taken in Galicia during the fortnight up to the 12th September.

ITALY.—The objectives of the Italians are the recovery of the Trentino and Trieste ; in the former area they are pressing on the fortified position of Trent, and if they succeed in cutting the Bozen—Triente railway, Trieste would probably fall.

MISCELLANEOUS.—Lord Kitchener stated in the Upper House that the 11 Divisions sent out from the New Armies had enabled Sir J. French to take over about 17 miles of the French front. He considered the Germans had "shot their last bolt" on the Eastern front : and that in Gallipoli there was abundant evidence of a process of demoralisation among the Turks : as to recruiting his anxiety was due to the falling off in the numbers coming forward to enlist.

*September 16th.*

WESTERN EUROPE.—Nothing occurred on the western front other than artillery actions of a violent nature in some sectors.

EASTERN EUROPE.—On the Northern front the enemy are making progress towards Dvinsk: but E. of the railway to Vilna they have been checked. In the southern portion of the battle front, the Austrians have fallen back West of the Strypa, after being defeated on the Sereth.

NAVAL.—Owing to the German claim to have sunk submarine E. 7. (Lt. Commr. A. D. Cochrane, R.N.) in Eastern waters and to there having been no news of her since 4th September, the Admiralty presume the report to be true: 3 officers and 25 men are said to be prisoners.

MISCELLANEOUS.—It is officially stated that the casualties up to the 21st August in the Mediterranean Expeditionary Force, including the Naval Division have been 87,630 of all ranks, including 1,130 officers and 16,478 men killed.

*September 17th.*

WESTERN EUROPE.—In Artois between Angres and Souchez and S. of Arras the French batteries violently bombarded the enemy's works and depôts. Artillery activity also occurred in other portions of the front.

EASTERN EUROPE.—Hindenburg's armies having cut the railway between Dvinsk and Vilna have penetrated 20 miles to the East, whilst their cavalry have advanced 60 miles. At Vilna the enemy are encircling the town, and are also approaching Dvinsk: the seizure of the entire line, of the R. Dvina appearing to be their design. In Galicia in the Tarnopol district there were marked Russian successes.

AIRCRAFT.—The net casualties of the week's raids in the London district have been 38 killed and 124 people injured.



## MILITARY NOTES.

### AIRCRAFT IN THE WAR.

BY H. MASSAC BUIST.

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Admiral Sir Percy Scott's appointment to take charge of the gunnery defences of London against attack by enemy aircraft may be taken as an official admission of the fact that the possibilities of employing Zeppelins for offensive operations in this war have been underestimated, and that, in consequence, the need to take measures to counter developments of this sort is now recognised. It is significant, too, that the appointment was announced on the day on which Parliament reassembled. Sir Percy Scott had been specially deputed by the Admiralty for very important work of another character, on which he has been engaged since an early stage of the war. The necessity for the Government to take such a measure is quite obvious to the man in the street, despite the fact that a large section of students of aeronautics have not yet got beyond the stage of sneering at what they are pleased to style the Zeppelin fiasco. The situation is one quite simple to define and void of secrecy. Obviously the work of defending London or any other large city from aerial attack in the hours of darkness must be entrusted either to anti-aircraft guns fired from ground or water level; or to airships as large as the Zeppelins it has taken Germany nearly half a generation to evolve. The latter plan is impracticable at present. Twelve months ago our calculations were based on the assumption that aircraft were immune from anti-aircraft missiles if they flew at between four and five thousand feet. The scores of thousands of British subjects who had their first views of German Zeppelins when the searchlights of London picked them out amid the darkness on the occasion of the most daring raid to date are curiously unanimous in summarising their impressions in words to the effect that the giant airships appeared each as a mere dot in the heavens above, and that for them it was no matter of surprise that such objectives should escape our marksmen.

At four or five thousand feet you are able quite easily to appreciate the magnitude of a Zeppelin; but it shrinks amazingly in appearance when it is navigated at from ten to twelve thousand feet, at which altitude these craft are to-day capable of long-distance cruising with full equipment of bombs. Unquestionably, too, the means has been discovered of enormously improving the accuracy of aim from these giant navigable balloons, so that to-day they are doing better work from altitudes of eight or ten thousand feet than they were a year ago, when they flew from two to four thousand feet high at the time of dropping their bombs. It may be recalled at this juncture that Colonel (now Brigadier-General) Seely assured the House of Commons, at the time the Army Estimates were under discussion a few months before the outbreak of war, that we had a wonderful anti-aircraft gun which practically rendered us immune from attacks of this sort. However wonderful that gun may have been, the only point that matters is that we have had nearly eighteen months in which further to perfect it and that to date, with one possible exception, not one of these instruments has fired a pro-

jectile that has touched a Zeppelin. In other words, Zeppelin airships have been developed proportionately to a greater extent than anti-aircraft gunnery as we have been employing it in these islands. That there are enormous possibilities of developing the anti-aircraft weapon is obvious from the fact that the range of the latest German ones is 18,000 feet, otherwise half as high again as the maximum altitude at which it is at present found practicable to navigate Zeppelins sent out over long distances to conduct offensive operations. Again, Paris is within more convenient range of Zeppelins operated from Belgium than is London; but the Zeppelins do not succeed in getting to Paris. Indeed, the Germans seem to have given up all attempts at such raids, despite the fact that on the Continent in practically every area in which armies are engaged airships are employed more or less regularly by both sides to cruise at night and drop bombs.

In the obvious necessity for keeping preparations secret, it is impossible to inform the public as to the extraordinary extent to which the aerial arms of the various nations are being developed in this war. It is not a mere matter of numbers; there is besides the fact that the sheer variety of aircraft is increasing to an almost bewildering extent. The idea has been expressed that there is "a tangle of responsibilities" in the Air Services. As matters stand to-day there is nothing of the sort, recent appointments being a mere logical development for apportioning tasks on a well-conceived plan now that a sufficient interval of time has elapsed to enable all the necessary branches of the Service to be got going and the important problem of supplying them with equipment has been solved. That is the meaning of the appointment of Commodore Murray Sueter, R.N., formerly Director of the Admiralty Air Department, to take charge of the material side of the naval work, with the title of Superintendent of Aircraft Construction. Commodore Sueter is practically the creator of our Naval Aircraft Service, and it is now necessary to leave him free to attend to the vast variety of constructional work as the war progresses. The increasingly large part which this expansion will render it possible for this Service to play in the war, in common with the Air Services of the other belligerents, is indicated by the appointment of a Flag officer in the person of Rear-Admiral Vaughan-Lee to the Directorship of the Admiralty Air Department, an office concerned with the utilisation of our ever-growing naval air fleet. This development had its parallel, too, at an earlier date in the war when the chief of the Army Air Service, the Royal Flying Corps, Sir David Henderson, was made a Major-General. The appointment of Britain's master-gunner, Sir Percy Scott, to take charge of the gunnery defences of the capital against attack of enemy aircraft need not necessarily result for some time in any obvious changes, since this brilliant officer's work has always been of a progressive character, and you cannot execute improvements the moment you conceive them. The public, however, may rest assured that a wiser step could not have been taken in that presently it will inevitably appear that in the ding-dong rave of mechanical progress in this war our anti-aircraft gunnery will spring a surprise on the Zeppelins such as will make them give us a wide berth for a period. No one nation engaged in this conflict can enjoy any advan-

tage for an indefinite period from possessing itself of a special weapon, each development in turn being countered by the production of machinery to dominate that which has hitherto been dominant.

### SIR J. FRENCH'S TESTIMONY.

Sir John French's informing despatch gives the public a glimpse of the increasing extent to which aircraft are being employed at the front. The chief points he makes are that in the space of five days during the operations at the end of September nearly six tons of explosives were dropped by our airmen on moving trains, and are known to have wrecked five of these, some containing troops, and to have damaged the main railway line in many different places. The General points out that the aeroplanes of the Royal Flying Corps engaged in carrying out continual bombing of the enemy's communications descend to 500 ft. and under to ensure accuracy of aim. This is in accordance with the official accounts of many other bomb-dropping expeditions undertaken since the beginning of the war by our naval and military flying services, and is more interesting in that it suggests that the improvement in anti-aircraft weapons is of comparatively little avail at such low altitudes, even though our attacks are carried out to a large extent in daylight. Of course, such low flights over the regions attacked are well within range of rifle shot. But a well-found machine can often weather a hail of missiles, as is revealed by the instance Sir John cites of an aeroplane that was hit in no fewer than three hundred places soon after crossing the enemy's lines, but in which the officer in charge, nevertheless succeeded in carrying out his mission. That there is much more elusiveness in aerial than in trench warfare is shown by the statement that in more than 240 combats in the air we brought down four of the enemy machines behind our own trenches, and at least twelve in the enemy's lines, while many more were seen to fall to the earth in a damaged condition or had to retire from the fight. This suggests that the enemy has changed his aerial tactics, and is content rather to retreat than lose men and machines in the wholesale fashion in which he sacrificed the cream of his aerial personnel during the first six months of the campaign, when we established our aerial mastery. Of course, so long as the enemy does not use his machines over the territory we hold, and so long as we make aerial reconnaissance and raids over his when and where we please, so long is he admitting our mastery in the air, and we are reaping the advantages of it. Apart from the increasing use of observation for the artillery from aeroplanes, Sir John draws attention to the increasing use of aerial photography, whereby all the enemy's activities are permanently recorded for the use of the General Staff.

#### Anti-Aircraft Weapons must be Mobile.

The student of the development of aerial navigation in this war will note the great difference between bomb dropping from aeroplanes and from navigable airships. The small, swift-moving aeroplane dives low not merely to ensure accuracy of aim, but particularly to make it difficult for the defenders to employ certain of their weapons against him while he is operating over points of military value, with



which alone the Allies concern themselves. It would, of course, be fatal for such a large target as a dirigible balloon to attempt similar tactics, hence the comparatively great height at which it operates even at night. When considering increases of altitude at which military aircraft of any sort have operated ever since the beginning of the war, we must not be misled by mere figures in the form of altitude records, because in peace time practically all these were established with aeroplanes or airships lightly equipped for the special task in hand in place of being laden with full complement of crew, munitions, and fuel for voyages of the longest possible range. Consequently, to compare the world's altitude records before the war with the heights at which aircraft on military service are navigating to-day is idle. Among the pre-war theories, too, that have been exploded, is that which assumed that the inherent advantage of the airship lay in the fact that it could remain poised at any altitude within its compass while dropping its bomb, whereas the aeroplane must travel continuously or come to earth. In practice we see to-day that the airship is a weapon which does not have to be halted over the objective on which its bombs are to be dropped. Instead, the missiles are released from it in full career, which sometimes means that it is travelling at more than a mile a minute, otherwise at speeds not widely different from those of many classes of military aeroplane. Naturally, the mobile anti-aircraft gun becomes a weapon of increasing use in face of these conditions. It will be observed that in his despatch Sir John French makes special mention of the enemy's use of these machines. In operating in regions where they chance to be, an airship captain who stopped his vessel to drop bombs would be in grave peril of destruction. Of course, the successful employment of mobile anti-aircraft guns is a highly specialised business, concerning which it will suffice to say that our authorities know quite well how the enemy uses these weapons.

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### ASPHYXIATING GASES.

The Germans first adopted these towards the end of April, 1915, in an attack on a portion of the allied front held by the French to the N.E. of the Ypres salient. Although various substances appear to have been employed, the chief was probably chlorine, a heavy greenish yellow gas which physically fulfils the conditions required for the purpose, and is capable of producing the asphyxiation (spasm of the glottis) and subsequent bronchitis which were the symptoms observed. The preparation of this gas, which can readily be reduced to the liquid form by moderate pressure at ordinary temperatures, was a large industry in Germany before the war.

Receptacles filled with the liquid being brought up to the trenches it is squirted from hose by its own pressure in the required direction resuming its gaseous form, when relieved from that pressure.

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From the "Times History of the War".

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